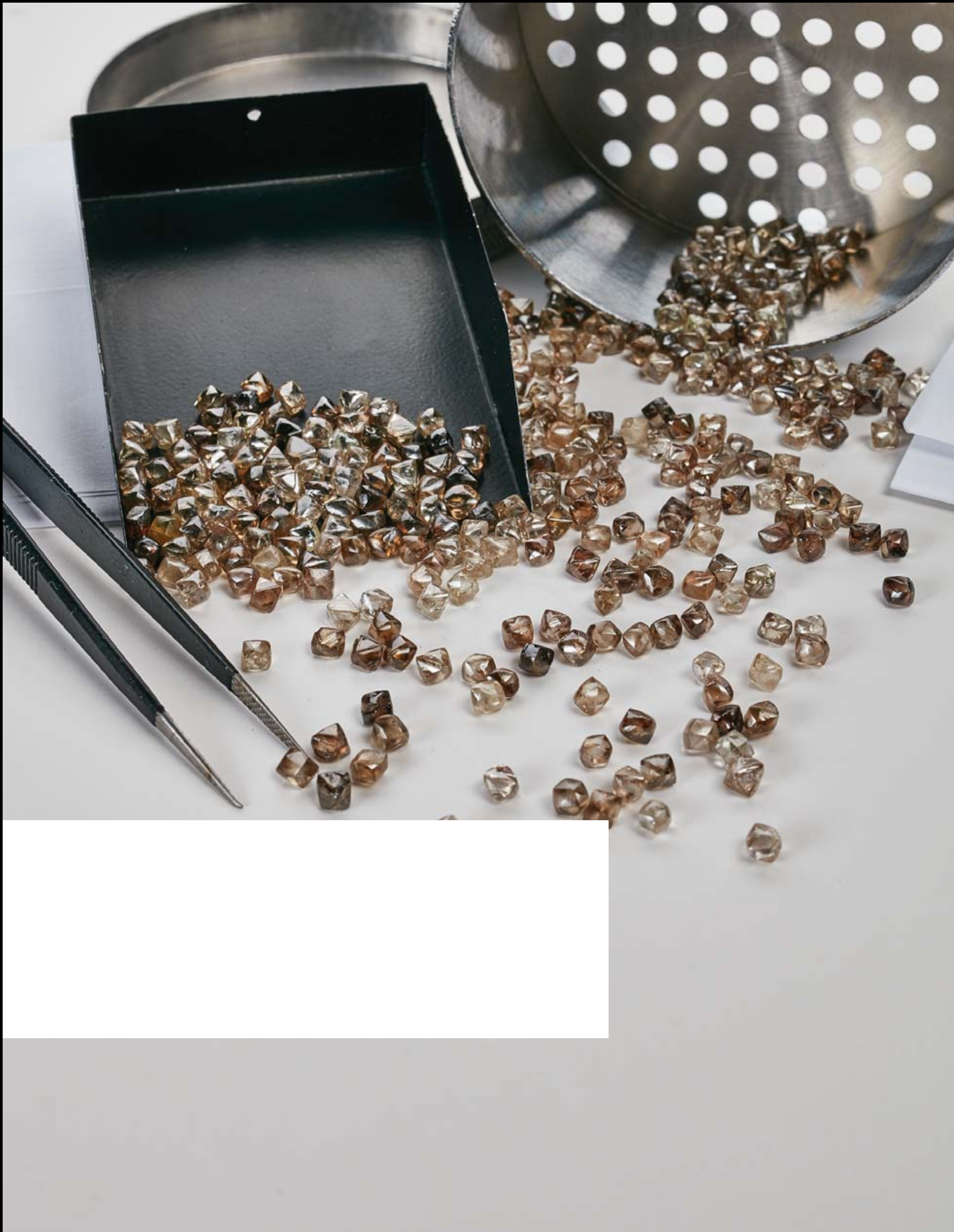
Summer 2015 $9.00 USD

Finer Points

SUPERABRASIVE INDUSTRY REVIEW

Featuring Natural Diamond Update and INTERTECH 2015 Excerpts



THIS ISSUE

IDA Annual Meeting Review

NTERTECH 2015 Featured Major Presentations on Research in Superabrasives Technology, New Material Introductions and Developments for Industrial Manufacturing

Natural Industrial Diamonds Are Here to Stay

"BEST IN CLASS" Education Course

IDA Member Companies

Calendar of Events

INTERTECH 2015 Paper Excerpts

News & Notes

New Products

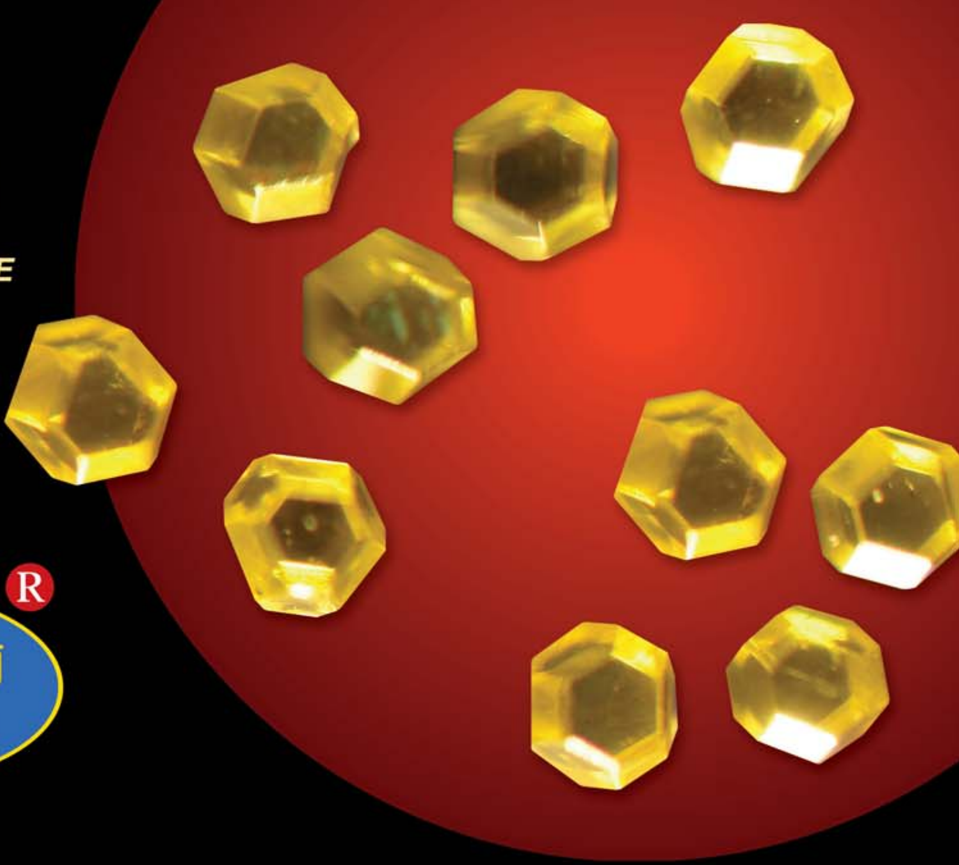
THE LONGEST RUNNING MAGAZINE DEDICATED SOLELY TO THE TECHNOLOGY AND APPLICATION OF SUPERABRASIVES

ZHONGNAN DIAMOND CO., LTD

… A GLOBAL MANUFACTURING FORCE

The largest manufacturer of synthetic diamond in China and one of the largest manufacturers of industrial diamond in the world.

中 南 ZHONGNAN



The Company Features:

TREMENDOUS CAPACITY

- Production facility with 2.4 Million Square meters (26 million square feet) of factory space
- Annual output of high-grade synthetic diamond and Cubic Boron Nitride (CBN) can be up to 6 billion carats
- More than 3000 highly skilled employees

STATE OF THE ART RESEARCH & DEVELOPMENT CENTER

- Providing High Quality, Innovation and New Technology

AN INTERNATIONAL SALES NETWORK

- Guarantees outstanding customer service and support at competitive prices

ADVANCED TESTING EQUIPMENT TO CONTROL QUALITY AND CONSISTENCY

- Superior crystal shape, diaphaneity, compact strength and thermal stability

COMMITMENT TO THE ENVIRONMENT

- Recycling up to 95% of production materials
- Waste water recycled 100%

AWARD WINNING OPERATIONS

- ISO 9001:2000
- China Top Brand
- High-Tech Enterprise Certification
- China Brand Award For International Market Innovation
- Certificate Of Conformity Of Quality System

中国名牌 CHINA TOP BRAND

Contact Us Today And Join The Growing International List Of Satisfied Zhongnan Diamond Customers…

IDA INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA, INC. MEMBER

US OFFICE

American Zhong Nan Inc.
17890 Castleton Street. Suite# 108
City of Industry, CA 91748 USA
Telephone: 626-839-2886
Fax: 626-839-0887
Email: chimayinc@hotmail.com
Website: www.diamond-zn.com

CHINA HEADQUARTERS

Zhongnan Diamond Co., Ltd.
P.O. Box 101
Fangcheng, Henan China 473264
Telephone: +86-377-67319259, 67319306
Fax: +86-377-67319212, 67318220
Website: www.diamond-zn.com

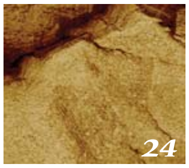
Finer Points

departments

4 A Finer Point of View
6 Editorial
14 IDA Member Companies
16 Calendar of Events
21 News & Notes
28 New Products

features

8 IDA Annual Meeting Review
9 INTERTECH 2015 Featured Major Presentations on Research in Superabrasives Technology, New Material Introductions and Developments for Industrial Manufacturing
10 Natural Industrial Diamonds Are Here to Stay
12 "BEST IN CLASS" Education Course – Superabrasives Materials, Principles & Applications
17 INTERTECH 2015 Paper Excerpts



COVER PHOTO

Cover photo shows an array of natural industrial diamond stones that are used throughout industry for multiple applications".

**Photo courtesy of Lieber & Solow Company*

FINER POINTS is the longest running publication devoted exclusively to the understanding, selection and application of diamond, cubic boron nitride and related materials. It is edited for recipients who are involved in some way with these "superabrasives", either as providers of the materials, producers of products containing the materials or users of these products (e.g., grinding wheels, dressing tools, drill bits, saw blades, sawing wires, cutting tools, polishing compounds, CVD film products, etc.).

advertisers

ABC Warren Superabrasives Saint-Gobain Surface Conditioning Group 18
Apogee Precision Parts 5
Bogimac NV-SA 6
CR Gems Superabrasives 23
Crystallume Engineered Diamond Products 13
DCM-TECH, Inc. 25
Element Six .... OBC
ILJIN USA, Inc. 15
LANDS Superabrasives .... IBC
Lieber & Solow Company 7
Niabraze 11
Ulbrich Stainless Steels and Special Metals, Inc. 28
Zhongnan Diamond Co., Ltd. .... IFC

A Finer Point of View…

I would like to thank the membership and Board of Directors for the vote of confidence in electing me as President of the IDA. As I look over the list of the past sixty eight Presidents I have personal known fifty nine of them and will do my best to uphold the traditions of the IDA. While it is important to have a sense if history it is very important to look to the future and make sure we are up to date on the latest technology in application, manufacturing and communication.

What do I hope to accomplish in my term as President.

1. Attempt to get more involvement of IDA members
2. Explore ways to better serve the membership
3. Build relationships with other trade associations whose members use diamond tools

Over the next few months I will be contacting all the IDA members and asking one simple question:

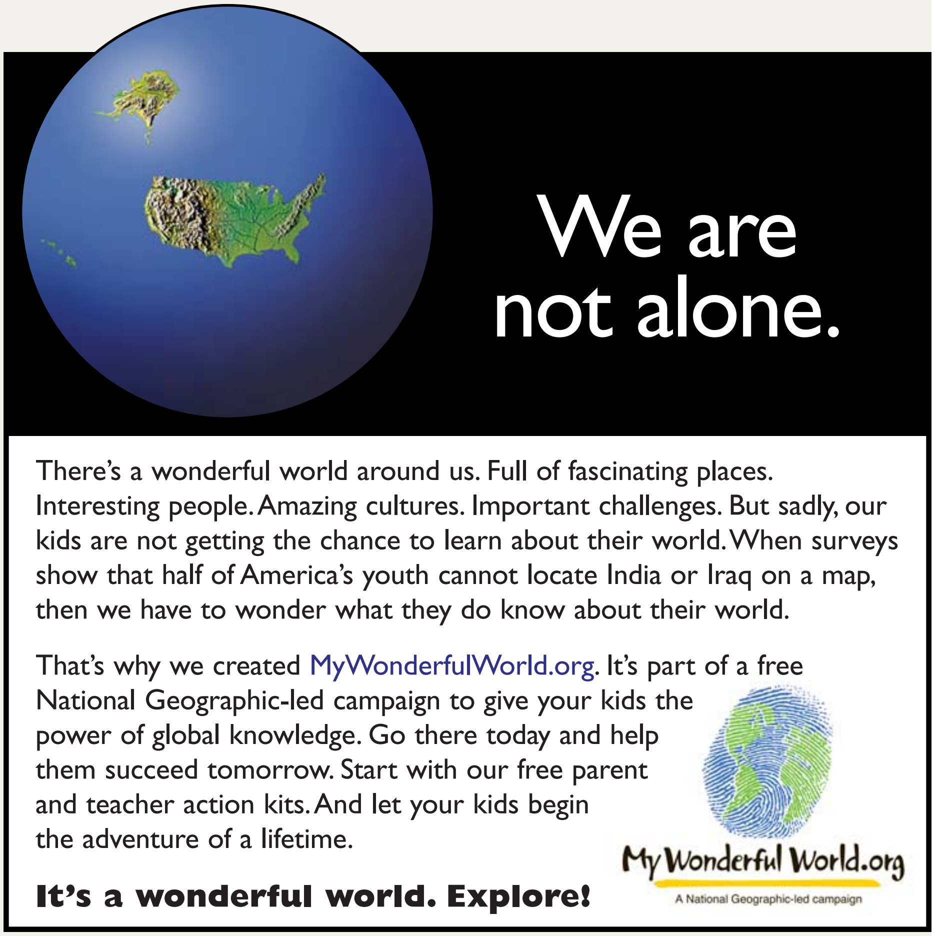
What can the IDA do to serve your company better and help you grow your business?

PRESIDENT
Keith Reckling

Please think about this question and I look forward to your suggestions and comments.

Sincerely,

Keith Reckling, IDA President 2015
Industrial Diamond Association of America



There's a wonderful world around us. Full of fascinating places. Interesting people. Amazing cultures. Important challenges. But sadly, our kids are not getting the chance to learn about their world. When surveys show that half of America's youth cannot locate India or Iraq on a map, then we have to wonder what they do know about their world.

That's why we created MyWonderfulWorld.org. It's part of a free National Geographic-led campaign to give your kids the power of global knowledge. Go there today and help them succeed tomorrow. Start with our free parent and teacher action kits. And let your kids begin the adventure of a lifetime.

It's a wonderful world. Explore!

Industrial Diamond Association of America, Inc.

PRESIDENT

Keith Reckling
National Research Company

VICE PRESIDENT

Ben Williams
FACT USA

SECRETARY/TREASURER

Ed Francis
Crystallume Engineered Diamond Products

PAST PRESIDENT

Joe Tabeling
Delaware Diamond Knives

BOARD OF DIRECTORS *(term)*

Scott Ries (13-15)
Vollmer of America Corporation

Stephen Griffin (14-16)
Engis Corporation

David Spelbrink (14-16)
Lieber & Solow Lands Division

Shane Hollenbaugh (14-16)
YG-1 USA

Matt Collier (15-17)
Vollmer of America Corporation

Kevin Stiles (15-17)
Radiac Abrasives, A Tyrolit Company

Aaron Nolan (15-17)
Worldwide Superabrasives

EXECUTIVE DIRECTOR

Mr. Terry M. Kane
Industrial Diamond Association
of America, Inc.
P.O. Box 29460
Columbus, Ohio 43229
Phone: 614-797-2265
FAX: 614-797-2264

E-Mail: tkane-ida@insight.rr.com

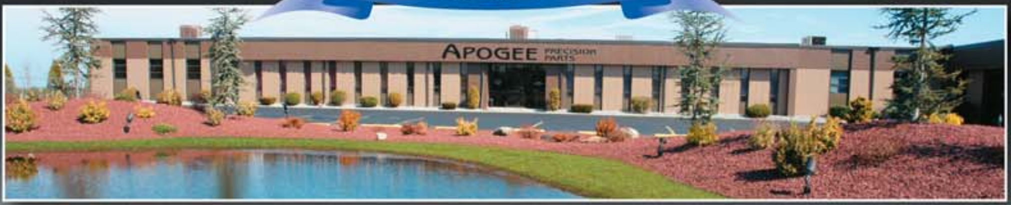
Website: www.superabrasives.org

FINER POINTS is the official publication of the Industrial Diamond Association of America, Inc. and is published fours times a year. Contributions are welcomed but the Editor reserves the right to accept or reject any material deemed inappropriate for publication. All by-lined articles published in this magazine represent solely the individual opinions of the writers and not necessarily those of the Industrial Diamond Association. Executive and Editorial Offices: Finer Points, P.O. Box 29460, Columbus, Ohio 43229, (614) 797-2265. Editor and Advertising, Terry Kane. Advertising rates and deadlines available upon request. Copyright Industrial Diamond Association of America. Material in FINER POINTS may not be reproduced in any form without express written consent.

ISSN: 1090-0896

APOGEE PRECISION PARTS

ISO 9001:2008 CERTIFIED



QUALITY SERVICE DESIGN

The Apogee design team is focused on your individual needs and requirements to insure that every aspect of your custom project will be handled with the highest degree of professionalism.

We offer a unique process that insures the highest quality product at the most competitive price and our staff understands the importance of a working relationship with our customers to guarantee their complete satisfaction.

You will be extremely pleased with our knowledge and unmatched quality due to decades of experience in drawing refractory metals including Tantalum, Niobium, Zirconium and Titanium cans and cups.

Call or email us today to discuss your individual requirements and allow us to provide you with a custom competitive quote.

55 Access Road • Suite 600 • Warwick, Rhode Island 02886 U.S.A.
(401) 732.3634 • Fax (401) 732.5237 • E-mail: info@apogeeparts.com • www.apogeeparts.com

IT’S ALL MATERIAL

TERRY KANE, Editor

A popular song from 1985 clearly stated: “You know that we are living in a material world”. Of course that songstress was singing the praises of jewels, cars and fashions while our “material world” is all about industrial materials that go into making cars, locomotives, aircraft, boats, heavy equipment, trucks, furniture, glass, medical devices and electronics just to name a few!

However, finishing the individual components of these major items would not be possible if it wasn’t for the various superabrasive tools of diamond and cubic boron nitride (cBN) that make processing these hard and tough materials a reality.

The main drivers are the aerospace and automotive industries where the aluminum and steel are in a constant battle to provide lighter and stronger materials. We all understand the importance of lighter and stronger in aerospace and superalloys, high silicon aluminum are achieving those solutions. Now, a new wave of composite materials is challenging even steel and aluminum.

The automotive industry has also been in the lighter and stronger mode to provide fuel efficiency and long life. From engines, brakes and drivetrains the introduction of metal matrix composites, bi-metals and aluminum have pushed out traditional cast iron and steel components.

In other industries such as woodworking we find wood-plastic composites that are still new materials relative to the long history of natural lumber as a building material for furniture, boats and other end uses. These materials are made of a combination of wood fibers, plastics and glue or resin which makes them extremely wear resistant, hard and abrasive to process.

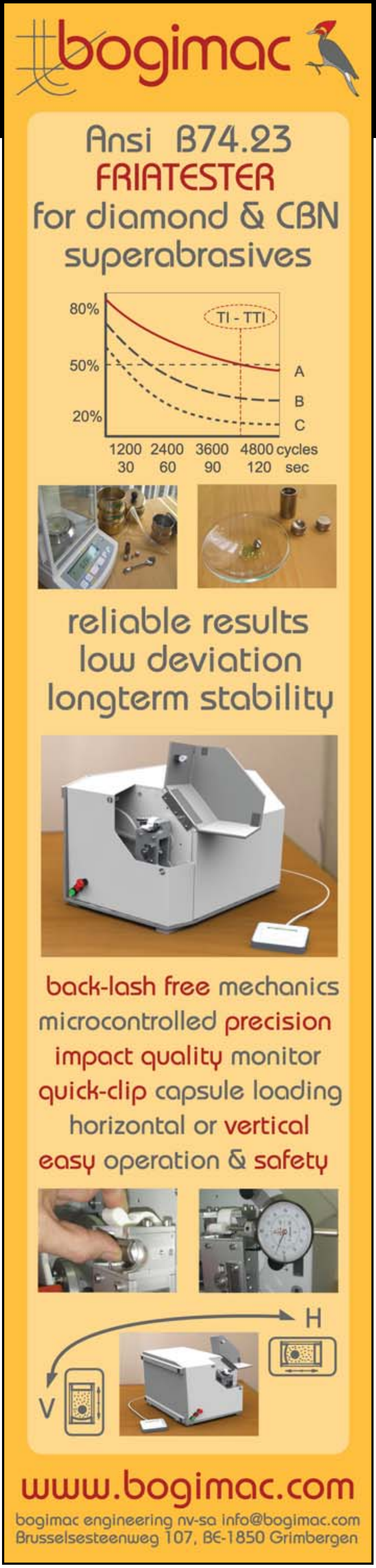
We also see traditional and new glass materials for optics and other uses including laser windows. Recently a new “metallic” glass has been touted as damage-tolerant and stronger than steel, demonstrating a strength and toughness beyond that of any known material. When this comes into the marketplace and where it will be used is still unknown but I am sure it will be a material that can only be finished with diamond. What’s more, even better versions of this new glass may be on the way.

Further developments in natural resource exploration for oil & gas and mining continues with new and creative drill bits and diamond drilling using large machines as the preferred method of delineating mineralization.

Of course no discussion of materials would be complete without giving notice to concrete and stone applications. In construction and renovation we see diamond tooling creating innovative solutions in the sawing and drilling of building sections. We can’t forget the grinding and grooving of highways and runways and of course large wire sawing applications on dams and bridges or quarrying of stone, all of these using diamond for speed and accuracy.

So whether it’s superalloys in aerospace, hardened steel in automotive, composites in wood, concrete in construction or drilling and mining of natural resources, the hard or tough materials throughout all industries can only be effectively drilled, sawn, ground, polished or machined with industrial diamond or cBN and therefore the material finishing material relationship is paramount.

At our recent INTERTECH we heard keynote speakers discuss quite a few materials from ceramic matrix composites (CMC) to steel and their advances. These materials are just the tip of the iceberg when it comes to all the materials being used in industry and the critical need for the superabrasives to make them viable in daily applications. No doubt about it ... ***“You know that we are living in a material world”***



bogimac

Ansi B74.23
FRIATESTER
for diamond & CBN
superabrasives

reliable results
low deviation
longterm stability

back-lash free mechanics
microcontrolled precision
impact quality monitor
quick-clip capsule loading
horizontal or vertical
easy operation & safety

www.bogimac.com
bogimac engineering nv-sa info@bogimac.com
Brusselsesteenweg 107, BE-1850 Grimbergen

Dressing with synthetic diamond?
...there is no point.

Make the *Natural* Choice.

L&S
Lieber & Solow, Co.
Natural Industrial Diamonds
Est. 1927

1156 Avenue of the Americas
New York, NY 10036, U.S.A.
212-354-4060 | info@lieberandsolow.com
www.lieberandsolow.com

IDA ANNUAL MEETING REVIEW

The 69th Industrial Diamond Association of America (IDA) Annual Meeting was held this past May prior to INTERTECH 2015 in Indianapolis, Indiana.

Mike Mustin introduces 2015 President Keith Reckling and hands over the silver gavel of leadership.

The main discussions of the Membership were regarding the educational program development and plans for the next Educational Course, ***Superabrasive Materials, Principles & Applications***. Even though the first stand-alone course was a tremendous success the Membership still wanted some improvements and suggested the course include more demonstrations and "hands on" grinding and machining application to complement the classroom presentations. Therefore this coming November the IDA will host the next Education Course at the YG-1 Technical Center in Charlotte NC.

Another discussion was held regarding holding our Annual Meetings in conjunction with UAMA in order to work Mike Mustin introduces 2015 President Keith Reckling and hands over the silver gavel of leadership together in future activities and provide solidarity in helping to grow our industry. In 2016 the IDA and UAMA will hold their first combined meeting. The General Membership also felt holding the Annual Meeting prior to INTERTECH may affect attendance and they opted to research holding General Membership meetings biennially instead of annually. The Board of Directors has drawn up a proposal and changed the Bylaws to allow for this provision. The General Membership also reviewed all the financials of the Association and Highlights of the past year which included the planning and organization of another successful INTERTECH conference and improvements of all our websites, for Finer Points, INTERTECH, Education and the IDA Website.

The Membership also felt that INTERTECH should go back to a three day conference instead of two days, so in 2017 INTERTECH will be in San Francisco, April 20th, 21st & 22nd at the Marriott San Francisco Airport Waterfront

The IDA welcomed two new Members to the Organization, Cemecon Inc. and Industrial Diamond Trading Company. The Membership recognized the efforts of the 2014 Board and welcomed the new Board of Directors ... *Troy Heuermann is no longer able to continue his duties as Past President due to the changes in his job and Joe Tabeling has agreed to take his place as Past President.*

OFFICERS

***President* – KEITH RECKLING**, National Research Corporation

***Vice President* – BEN WILLIAMS**, FACT USA

***Secretary/Treasurer* – ED FRANCIS**, Crystallume Engineered Diamond Products

***Past President* – Joe Tabeling**, Delaware Diamond Knives

DIRECTORS

MATT COLLIER, Element Six

STEPHEN GRIFFIN, Engis Corporation

DAVID SPELBRINK, Lieber & Solow Lands Division

KEVIN STILES, Radiac Abrasives, A Tyrolit Company

SCOTT RIES, Vollmer of America Corporation

AARON NOLAN, Worldwide Superabrasives, Solids Division

SHANE HOLLENBAUGH, YG-1 USA

MANAGEMENT

TERRY KANE, IDA Executive Director

KATHY KANE, IDA Business Manager

INTERTECH 2015 FEATURED MAJOR PRESENTATIONS ON RESEARCH IN SUPERABRASIVES TECHNOLOGY, NEW MATERIAL INTRODUCTIONS AND DEVELOPMENTS FOR INDUSTRIAL MANUFACTURING

INTERTECH 2015
An International Technical Conference on Diamond, Cubic Boron Nitride and their applications.
www.intertechconference.com
Indianapolis Downtown Marriott
INDIANAPOLIS, INDIANA USA
May 19 & 20, 2015

The Industrial Diamond Association of America (IDA) recently hosted another successful INTERTECH Conference. Those who were lucky enough to attend were treated to some outstanding technical presentations highlighted by four superlative Keynote addresses by leading materials scientists and researchers. Attendees heard from Dr. R. Byron Pipes - John L. Bray Distinguished Professor of Engineering with joint appointments with Materials, Chemical, and Aeronautics & Astronautics Engineering. He is engaged in research on the incorporation of carbon nanotubes into polymer matrix composite materials as reinforcing components. He discussed the successes of ventures in polymeric materials and their composites. Keynote speaker Dr. Robert Cook, Senior Materials Engineer and Ceramic Matrix Composite Technical Lead at Lancer Systems spoke on application-specific CMCs for aerospace, defense and industrial applications and the design and processing of polymer-derived CMCs consisting of either silicon oxycarbide, silicon carbide or silicon nitride matrices. These high-performance materials are commonly reinforced with either carbon, ceramic, alumina or quartz fibers, and can be filled with additional particulate material depending on desired composite bulk and surface property requirements. Another keynote address was given by Dr. Ji-Cheng (JC) Zhao who currently serves as a Program Director at the Advanced Research Projects Agency-Energy (ARPA-E). His research spans lightweight magnesium alloys for transportation, low-modulus biocompatible titanium alloys for biomedical prosthetic devices, high-temperature steels for advanced ultrasupercritical (AUSC) steam turbines, hightemperature alloys for jet engines, computational alloy design approaches, and high-throughput experimental methodologies for accelerated discovery/development of advanced materials. We also heard from David Anderson, Senior Director Automotive Technical Panel and Long Products Program Steel Market Development Institute (SMDI) he spoke on new steel applications and his efforts to grow steel long products in the North American automotive / heavy equipment and construction / infrastructure markets.

KEYNOTE DR. R. BYRON PIPES

SOCIAL NETWORKING EVENT

The audience learned about the developments in steel and new composites. Technical sessions were both diverse and held the interest of all attendees as the outstanding presentations ranged from polycrystalline and crystal developments to diamond and cBN developed for new applications. Over 170 attendees, presenters and coauthors representing 80 companies from 16 different countries showed up to hear all about the latest superabrasive technology and new application developments.

Each day everyone had the opportunity to visit a range of tabletop exhibits and discuss product and services available to the industry. Of course one of the strengths of INTERTECH is the networking provided through dining and social events for attendees.

A PACKED TECHNICAL SESSION

From initial feedback attendees were pleased with the entire conference including accommodations and amenities and are looking forward to INTERTECH 2017 and they will not be disappointed. INTERTECH 2017 will build on the basics of previous INTERTECH conferences and establish an outstanding program at the Marriott San Francisco Airport Waterfront in California. After 15 years INTERTECH has an excellent base of presenters and attendees and the future looks bright for this mainstay in the superabrasives industry. Every INTERTECH has its own signature and draw and in April of 2017, we will continue this tradition as INTERTECH 2017 will feature a full materials theme for all industries. Make your plans and we will ***see you at INTERTECH 2017 San Francisco, California USA … you will not be disappointed!***

NETWORKING AT TABLE EXHIBITS

TECHNICAL PRESENTATION MAIN FEATURE

Natural Industrial Diamonds Are Here To Stay

By: Arnold Lieber, Steve Roffman and David Spelbrink

Looking back, we can see that whether it was with the advent of synthetic diamond powders, PCD, the CVD log, the HPHT stone or the CVD single crystal, each decade has brought another invention which producers claim would eliminate the use of natural diamond as an industrial material. In fact, the most interesting concept with regard to Industrial Diamond Tooling is that both Natural and Synthetic diamonds are being used today in a wide range of tooling applications. While the purveyors and miners of natural diamond might prefer a world without synthetic diamonds, this is not the reality. Similarly, synthetic producers and vendors might prefer a world without natural diamonds; this is also not a reality. Both products, natural and synthetic diamonds, have a place in today's industrial world. There are many areas of crossover and applications where the two complement one another, but in some applications, one of these materials may be the better choice. As synthetics are the relative newcomer on the scene, they have clearly expanded the use of diamonds in industry. But the prediction of the demise of natural diamond as an important industrial material has been greatly exaggerated. Ask the producer of single point dressing tools, of form dressing tools, or diamond dressing rolls, and they will tell you why natural diamond continues to be the best choice in the grinding industry. And this holds true for particular applications in wire production, precision cutting and superfinishing. Nobody questions the continued importance of natural diamonds in industry today, but natural industrial users have become concerned about the reliability of supply. In this article, we address this in order to put aside any concerns end-users may have regarding the availability of natural industrial diamonds for their applications.

MINING AND DISTRIBUTION OF NATURAL DIAMOND

In the recent past, about 85% of natural diamond production was mined and marketed by one major company, DeBeers. Today, DeBeers mines and markets approximately 35% of global production. The balance of the world production is being shared by other major mining groups such as Alrosa, Rio Tinto, Dominion Diamond, Petra and a group of smaller producers. Mining and exploration continue to be done in the traditional areas of Africa as well as Russia, Australia and Canada. To bring perspective to this discussion, according to Bain and Companies Diamond Report of 2014, the estimated global production for 2013 was about 130 million carats. Of this quantity, it is estimated between 65 to 75 million carats was used exclusively by the jewelry market. The balance of 55 to 65 million carats is considered industrials. Most of this is low grade material called industrial boart. Boart has no intrinsic gem value and is primarily used as crushing material to produce natural diamond mesh and micron, as well as other industrial items used in various drilling, dressing and abrasive applications.

Within the entire production of diamonds mined, there is a middle range of rough which is considered "Near Gem" material. These materials are selected from the lower end of the gem quality range as well as the top end of the industrial materials. We estimate the near gem content of diamonds mined in 2013 would have been approximately 15 to 20 million carats, or 10 to 15% from all diamonds mined. It is from the near gem materials as well as some higher end rough materials where specialized industrial diamond suppliers select, assort and market tool and die stones for specific industrial applications. All the available industrial materials from the worldwide diamond production of 2013 was more than enough to meet any and all natural industrial diamond requirements. So we ask the question, why are there concerns?

NATURAL INDUSTRIAL DIAMONDS AND THE MYTH OF DIMINISHING SUPPLY

There appears to be a myth circulating through the diamond industry that there is and will be a shortage of natural industrial materials. The propagation of that myth is undermining the confidence of users. This is a myth and is simply not true.

These are the facts:

- All natural industrial demands are being supplied without interruption as there is more than enough diamond mined to meet industrial demands.

- These large volumes of critical industrial materials are made available to industrial dealers by the major mining and distribution groups.
- These producers are strong, profitable companies that will continue mining to meet large and growing diamond demands.
- Rough diamond mining levels are predicted to grow through 2020.
- Thereafter new mines that are now in startup phases will come online with new large scale productions.
- Funding and a commitment for exploration will bring to market new mining productions.
- Advances in mining technologies will expand the yields of existing mines.

In fact, DeBeers has committed to long term industrial contracts with allocated industrial assortments sold through their dedicated industrial sight holders. All of these facts ensure suppliers will continue to meet the growing industrial diamond demands. Today's complex market requires a great variety of tools. Natural diamond remains one of the most flexible and sought after materials. The dressing of advanced ceramic wheels is done most effectively and efficiently with natural diamond; many metals for fine wire are best pulled through a natural die stone; precision natural diamond cutting tools perform better on any number of high end critical applications.

Natural diamonds have true points, hold shape and sharp edges, dissipate heat, take wear and are available in a complete range of sizes, crystal types, orientations and price points giving the tool maker the advantage of flexibility within his tool-box. History has taught us that decade after decade; the market speaks and demands that natural diamond continues to be an important material in dressing, cutting and wire drawing. Diamond tool manufacturers are aware that the natural material they require has been and will be available through their traditional sources. The fact is, natural diamond for industry is available today, will be available tomorrow, as well as for future generations of tool makers and users. End users can be confident of this fact.

The myth that natural diamond will not be available for industry has been shown to be just that: a myth … NATURAL DIAMONDS ARE HERE TO STAY

Advances in mining technologies will expand the yields of existing mines.

NIABRAZE

Specializing in Electroplated and Brazed Diamond Tooling

- Diamond Band Saw Blades
- Diamond Circular Saw Blades
- Diamond Hole Saws
- Diamond Wheels
- Custom Tooling

www.niabraze.com
675 Ensminger Road
Tonawanda, NY 14150
716.447.1082 or 1.800.782.9289
sales@niabraze.com

THE COMPETITIVE EDGE
in superabrasive products

THE INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA (IDA)
Presents

"BEST IN CLASS" Education Course

Superabrasive Materials, Principles & Applications

EXPANDED TWO DAY COURSE! - November 17 & 18, 2015

FEE: $500 USD - EARLY PAYMENT (BY OCTOBER 15, 2015): $450 USD

YG-1 America, Inc. Advanced Manufacturing Center
11001 Park Charlotte Boulevard • Charlotte, NC 28273 USA

ATTENDEES MAY SELECT ONLY THE ONE DAY OF MACHINING OR GRINDING AT $275
EARLY PAYMENT (BY OCTOBER 15, 2014) AT $250 USD

www.superabrasiveseducation.com

In an effort to continually improve the education on superabrasives the Industrial Diamond Association has expanded their education course to two full days dedicating one day to grinding and one day to machining

OBJECTIVE

"Superabrasive Materials Principles and Applications" is sponsored by the IDA and designed specifically to educate on the use of industrial diamond, cubic boron nitride (cBN) materials classified as superabrasives. It is Non-commercial, unbiased and representative of accepted principles and practices. Content will include a wide range of products and applications for the automotive, aerospace, medical, electronics, optics and other industries using superabrasives. The attendee will be educated in the primary areas of grinding and machining with peripheral explanation for other uses, such as non-abrasive applications.

WHO SHOULD ATTEND?

This Course will educate End Users processing materials made from difficult to machine and grind materials such as hardened steel, stainless steel, superalloys, titanium, high silicon aluminum, composites, ceramics, bi-metals, metal matrix composites, cermets, glass, and more! It will also educate Machine Tool Builders, Abrasive suppliers, Raw Material Suppliers, Machine Operators, Wheel Makers, Tool Makers, Research Scientists, Academia, Engineers, Sales Personnel or anyone wishing to learn more about superabrasives.

INSTRUCTORS ARE INDUSTRY EXPERTS WITH MANY YEARS COMBINED EXPERIENCE!

Each one has with “real world” knowledge of superabrasives, applications and characteristics. They have already established manufacturing operations in aerospace, automotive and literally every other production operation around the world. Now, you can learn what superabrasives are, where they are used and the characteristics and properties that affect their performance in manufacturing operations. Do you want to understand wear mechanisms in machining and grinding? What is friability? What is a rake angle? What affects chip formation? What crystal is used in a given application? How does burn and thermal damage affect structural integrity of a part? What is residual stress in metal components such as turbine engine fan blades? Why true & dress a wheel? What are the different coolant types and delivery systems? What is edge prep on a cutting tool and why is it performed? What is the Modulus of Resistance and what abrasive performs best on a particular workpiece material and why? If you currently are using conventional abrasives you will learn the advantages of superabrasives and how they can be applied to increase productivity, reduce scrap and improve the cost effectiveness in manufacturing operations.

EDUCATION CRITICAL TO MANUFACTURING SUCCESS

Education has been a major topic across all news media and trade publications. The US Government has even initiated programs that address the issue of a manufacturing workforce that is seriously lacking skilled labor. With companies reshoring or retooling existing operations to meet rising productivity demands, new operations have seen an influx of sophisticated machines. To match this technological upheaval, it has become paramount that skilled labor and management be educated in the characteristics, properties and performance of the new-age abrasives being applied. Going back almost seven decades the IDA has set the standard for education and training, from natural diamond to manufactured superabrasives the IDA has always been in the forefront educating a workforce on the advantages and application of these materials.

FIND ALL SPECIFICS AND REGISTER TODAY AT: WWW.SUPERABRASIVESEDUCATION.COM

Crystallume CVD Diamond

Crystallume has been manufacturing CVD Diamond since1984 with nine CVD production systems available.

- Diamond on Tungsten Carbide
- Diamond on Silicon
- Diamond on GaN
- Diamond on Silicon Carbide
- Diamond on Graphite
- Free Standing Diamond
- Complex Geometries
- SEM and TC Analysis In-house

Crystallume
A DIVISION OF ROBBJACK CORPORATION

crystallume.com

INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA (IDA)

MEMBER COMPANIES

Contact an IDA Member Company for superior products and services related to the superabrasives and ultra-hard materials industry. IDA Members follow a strict code of ethics to guarantee quality and dependability.

ALWAYS BUY FROM AN IDA MEMBER!

3M Abrasive Systems Division
Website: www.mmm.com

ABC & Warren/Amplex Superabrasives
Website: www.saint-gobain.com

Abrasive Technology
Website: www.abrasive-tech.com

Abrasivos Austromex, S.A. DE C.V.
Website: www.austromex.com.mx

Action Superabrasive Products, Inc.
Website: www.actionsuper.com

Advanced Abrasives Corporation
Website: www.advancedabrasives.com

American Superabrasives Corp.
Website: www.diamonds-abrasive.com

Anco Industrial Diamond Corp.
Website: www.ancodiamond.com

Apogee Precision Parts
Website: www.natchain.com

Asahi Diamond America
Website: www.asahidiamond.com

Bogimac NV-SA
Website: www.bogimac.com

Bruce Diamond Corp.
Website: www.brucediamond.com

Cdp Diamond Products Inc.
Website: www.cdpdiamond.com

CemeCon Inc.
Website: www.cemecon.com

Chardon Tool & Supply Co., Inc.
Website: www.chardontool.com

Continental Diamond Tool Corp.
Website: www.cdtusa.net

Crystallume Engineered Diamond Products
Website: www.crystallume.com

Cutting Edge Services Corporation
Website: www.cuttingedgeservices.com

DCM-TECH, Inc.
Website: www.dcm-tech.com

Delaware Diamond Knives Inc.
Website: www.ddk.com

Desmond-Stephen Mfg Co.
Website: www.desmond-stephan.com

Dev Industrial Corp.
Website: www.dev-group.com

Diamond Industrial Tools
Website: www.todit.com

Dianamic Abrasive Products Inc.
Website: www.dianamic.com

Eastwind Lapidary, Inc.
Website: www.eastwinddiamondabrasives.com

Element Six
Website: www.e6.com

Eloquence Corporation
Website: www.corporationwiki.com/New-York/New-York/eloqence-corporation/36629788.aspx

Engis Corp.
Website: www.engis.com

FACT USA
Website: www.wmstrading.com
Website: www.factdiamond.com

Fives Landis Corp-Citco/Gardner
Website: www.fivesgroup.com

Fort Wayne Wire Die Inc.
Website: www.fwwd.com

Greenlee Diamond Tool Co.
Website: www.greenleediamond.com

Iljin USA, Inc.
Website: www.iljindiamond.com

Industrial Diamond Laboratories Inc.
Website: www.industrialdiamondlabs.com

Industrial Diamond Trading Corporation
Website: N/A

K & Y Diamond Ltd
Website: www.kydiamond.ca

Lach Diamond, Inc.
Website: www.lachdiamond.com

Lieber & Solow Co.
Lands Superabrasives Co.
Website: www.lieberandsolow.com
Website: www.landssuperabrasives.com

Lunzer Technologies, Inc.
Website: www.lunzer.com

Mapal Inc.
Website: www.us.mapal.com

Megadiamond Inc.
Website: www.megadiamond.com

Morgan Advanced Materials and Technology
Website: www.morganplc.com

NanoMech
Website: www.nanomech.biz

National Research Co.
Website: www.nationalresearchcompany.com

Niabraze Corp.
Website: www.niabraze.com

Noritake Co Inc.
Website: www.noritake.com

Pinnacle Abrasives
Website: www.pinnacleab.com

Precision Eforming
Website: www.precisioneforming.com

Protech Diamond Tool Inc.
Website: www.protechdiamondtoolsinc.com

Radiac Abrasives Inc.,
A Tyrolit Company
Website: www.radiac.com

Sandvik Hyperion
Website: www.hyperion-sandvik.com

Saint-Gobain Surface Conditioning Group (Saint-Gobain Ceramic Materials)
www.innovativeorganics.com

Scio Diamond Technology
Website: www.sciodiamond.com

sp3 Cutting Tools Inc.
Website: www.sp3cuttingtools.com

Spec Tool
Website: www.spec-tool.com

Standard Die & Fabricating Inc.
Website: www.standarddie.com

H.C. Starck, Inc.
Website: www.hcstarck.com

Sumitomo Electric Carbide Inc.
Materials Group
Website: www.sumicarbide.com/diamondgroup

Superabrasives Inc.
Website: www.superabrasives.com

Syntech Abrasives Inc.
Website: www.syntechabrasives.com

Tomei Corp. of America
Website: www.tomeidiamond.com

US Synthetic Corporation
Website: www.ussynthetic.com

Ulbrich Stainless Steels & Special Metals, Inc.
Website: www.ulbrich.com

Vollmer of America Corporation
Website: www.vollmer-us.com

Wemex Superabrasivos, S. DE R.L. DE C.V.
Website: www.wemex.com.mx

Worldwide Solids, LLC
A Division of Worldwide Superabrasives, LLC
Website: www.worldwidesolids.com

Worldwide Superabrasives, LLC
Website: www.worldwidesa.com

YG-1 USA
Website: www.yg1usa.com

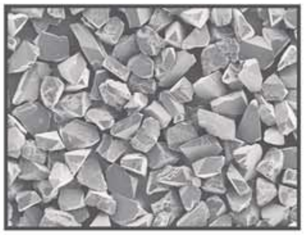
Zhongnan Diamond Co., Ltd
Website: www.diamond-zn.com

ILJIN For Your Superhard Material Solutions

ILJIN Diamond

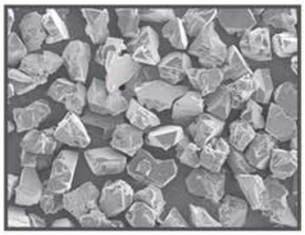
IBN

- Cubic Boron Nitride products suitable for grinding automotive and aerospace components



√ Low power consumption
√ Sharp cutting-edge
√ Fast regeneration of sharp cutting edge
√ Longer tool life

Excellent for
Cam · Crankshaft Grinding



√ Friable & Irregular shape
√ Low power consumption
√ High efficiency production
√ Sharp cutting-edge

Excellent for
Bearing Grinding

IBON

- PCBN (Polycrystalline Cubic Boron Nitride) composites available from low CBN content to high CBN content

for
√ Cast Irons - Roughing: SB100 (Solid), Finishing: SB95N, SB95S2
√ Hardened Steels Continuous - SB500, SB600
√ Hardened Steels Interrupted - SB650, SB600, SB630, SB700
√ Powdered Metals - SB700, SB95S2, SB95N
√ Solid Form Available - SB100, SB500, SB600, SB630, SB650, SB700
√ RTG (Ready To Grind) Available: Brazed Semi-Finished

Tungsten Carbide products

- Available in various specifications

for
√ PCB Micro Drill - N810X, M710
√ PCB Router and End Mill - HF6
√ End Mill, Drill, Reamer
  - EF8: Hardened steel, Cast iron, Al alloy
  - EF10, HF10, TH1008: General steel, Stainless steel, Ti alloy
  - EF12, HF12: Soft steel, Stainless steel, Cast iron
  - TH608: CFRP, Graphite (for CVD Diamond Coating)

- **ILJIN USA Inc.** 11999 Katy Freeway Suite 605, Houston, TX 77079, USA TEL: 281-448-5111 FAX: 281-448-5114

Calendar of EVENTS

To have your event or conference listed, please send information to: Finer Points Event Calendar • P.O. Box 29460, Columbus OH 43229 • Fax 614-797-2264 or email: tkane-ida@insight.rr.com

AUGUST 31 – SEPTEMBER 2, 2015
Additive Manufacturing for Defense and Aerospace
Embassy Suites by Hilton Springfield
Springfield, Virginia USA
http://www.additivemanufacturingfordefense.com

SEPTEMBER 10-11, 2015
CSDA Fall Board & Committee Meetings
Denver Marriott City Center
1701 California Street
Denver, Colorado 80202 USA
info@csda.org
Phone: 727-577-5004

SEPTEMBER 15-17, 2015
WESTEC 2015
Los Angeles Convention Center
1201 South Figueroa Street
Los Angeles, CA USA
Phone: 213-741-1151
http://westeconline.com

SEPTEMBER 28 – OCTOBER 1, 2015
The Canadian Manufacturing Technology Show (CMTS)
The International Centre
6900 Airport Road
Mississauga, Canada
Phone: 1-800-567-1199
http://cmts.ca

OCTOBER 4-8, 2015
Materials Science & Technology 2015
Greater Columbus Convention Center
Columbus, OH, USA
http://matscitech.org

OCTOBER 5-8, 2015
64th IWCS Conference
Hyatt Regency Atlanta
265 Peachtree Street
Northeast, Atlanta, GA 30303 USA
http://www.wirenet.org

OCTOBER 5-10, 2015
EMO Milano 2015
FIERAMILANO
SS 33 del Sempione
Rho, Italy
Phone: 39 02 4997 1
http://www.emo-milano.com/home

OCTOBER 27-29, 2015
SOUTH-TEC 2015
Charlotte Convention Center
501 South College Street
Charlotte, NC USA
Phone: 704-339-6000
http://www.southteconline.com

NOVEMBER 2-4, 2015
Unified Abrasives Manufacturers' Association Fall Business Meeting
Newport Marriott
Newport, RI USA
www.uama.org

NOVEMBER 9-12, 2015
FABTECH 2015
McCormick Place
2301 S. Martin Luther King Drive
Chicago, IL USA
Phone: 312-791-7000
http://www.fabtechexpo.com

NOVEMBER 17, 2015
Industrial Diamond Association of America
Superabrasive Materials, Principles & Applications
Education Course –
YG-1 America, Inc. Advanced Manufacturing Center
11001 Park Charlotte Boulevard
Charlotte, NC 28273 USA
Watch for details at:
www.superabrasiveseducation.com

2016

APRIL 11-13, 2016
Industrial Diamond Association of America Biennial Meeting in Conjunction with UAMA
Longboat Key Club
Longboat Key, Florida USA
www.superabrasives.org

MAY 2-5, 2016
Offshore Technology Conference (OTC)
Conference & Exhibition
NRG ParkOne NRG Park
Houston, Texas 77054 USA
Phone: 1-832-667-1400
http://2016.otcnet.org/

2017

APRIL 20, 21 & 22, 2017

Marriott San Francisco Airport

INTERTECH 2017
An International Technical Conference on Diamond, Cubic Boron Nitride and their applications.
www.intertechconference.com
San Francisco Airport Marriott Waterfront
BURLINGAME, CALIFORNIA USA
April 20, 21 & 22, 2017

Waterfront
San Francisco, California USA
www.intertechconference.com

Paper Excerpts of INTERTECH 2015 on the following pages.

STATUS OF AWJ MACHINING OF CMCS AND HARD MATERIALS

M. Hashish [1], A. Kotchon [1] and M. Ramulu [2]
[1] Flow International Corporation, Kent, WA USA
[2] University Of Washington, Seattle, WA

ABSTRACT

The abrasive Waterjet (AWJ) technology has been demonstrated to cut any material including ceramics, ceramic matrix composites and other hard materials such as carbides, and PCD. It was found that the relative hardness of the abrasive material to the workpiece is an important factor. For example garnet, which is the most commonly used abrasives, is adequate for cutting metals such as steel, aluminum and titanium. Cutting ceramics and carbides with garnet abrasives, while possible, is relatively slow. Higher cutting rates are obtained with aluminum oxide and silicon carbide abrasives but the tungsten carbide mixing tube wears out at a faster rate that may not be economical for some applications. This paper presents results on the above observations and shows the capabilities of AWJ in cutting, drilling, milling, and turning CMCS, and hard ceramics and carbides. While the current AWJ technology can be implemented for cutting and drilling some CMCs, future trends and needs to advance the AWJ technology for machining hard materials are discussed.

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD • Order at www.intertechconference.com

1. INTRODUCTION

Ceramic matrix composites (CMCs) are strong, wear-resistant materials with growing demand in fields with high-temperature, corrosion-resistant applications, such as energy and aerospace. Machining CMCs using conventional methods such as milling and grinding can be difficult due to the hardness and brittleness of the compound. Associated issues include high tool wear, slow machining speed, and cracking of the part. As a result, alternative methods, such as EDM, laser, ultrasonic, and waterjet machining are also used to manufacture CMC parts.

Abrasive waterjet (AWJ) technology has been used to cut, drill, and mill CMC alumina and SiC/SiC based composites, as well as hard materials such as sapphire. Cut quality will be shown in detail and compared to alternative methods. The suitability of AWJ systems for machining CMC composites and other hard materials will be discussed, along with associated challenges. Future developments and applications for AWJ machining of CMCs will also be presented.

2. LITERATURE REVIEW:

Ceramic composites present machining challenges due to their unusual strength and brittleness. Commercially, two important CMCs are silica (SiC/ SiC) and alumina (Al2O3/Al2O3) due to their ability to elongate. Conventional tools, such as diamond-coated grinding wheels, drills, mills, and routers, face short life expectancies, as well as time constraints, when used to machine CMCs. Both of these factors increase the cost of machining CMCs using conventional tools. Additionally, these methods can create heat-affected zones (HAZ) in the part, or impart high tool loads on the workpiece, increasing chipping [1]. Tool load can be significantly reduced through laser-assisted machining, which uses a laser to heat a thin layer of the target material during cutting [2].

Laser-only cutting is also used on CMCs, allowing thin and webbed features to be machined by eliminating tool-workpiece contact [3]. The heat of the laser affects the material properties and surface finish of the workpiece, which can be both detrimental and beneficial, depending on the application [4] [5]. Compared to conventional methods, laser cutting can also improve the attainable feed rate of the cutting process. With higher feed rates, however, comes increased kerf taper and poor edge finish in the workpiece.

Electro-discharge machining (EDM) is known for producing high quality edge finish, often at the expense of speed. Similarly to laser cutting, it does not impart tool stress on the workpiece during cutting. Challenges can occur when cutting CMC materials due to uneven conductivity in the workpiece [6].

Abrasive waterjet (AWJ) cutting systems use a high pressure stream of water injected with abrasive particles to blast and erode material [7]. Compared to conventional methods, it induces low stress in the workpiece and improves cutting time. Tool wear is also less since the nozzle does not directly impact the part. Unlike laser and EDM, there are no localized effects from heat on the workpiece.

Trimming and Slotting of Carbon Fiber Reinforced Polymer (CFRP) with PCD End Mills

***M. Lay* [a]*, W. Leahy* [a]*, D. O'Malley* [a]*, T. Geisb, W. Hintze* [b]**

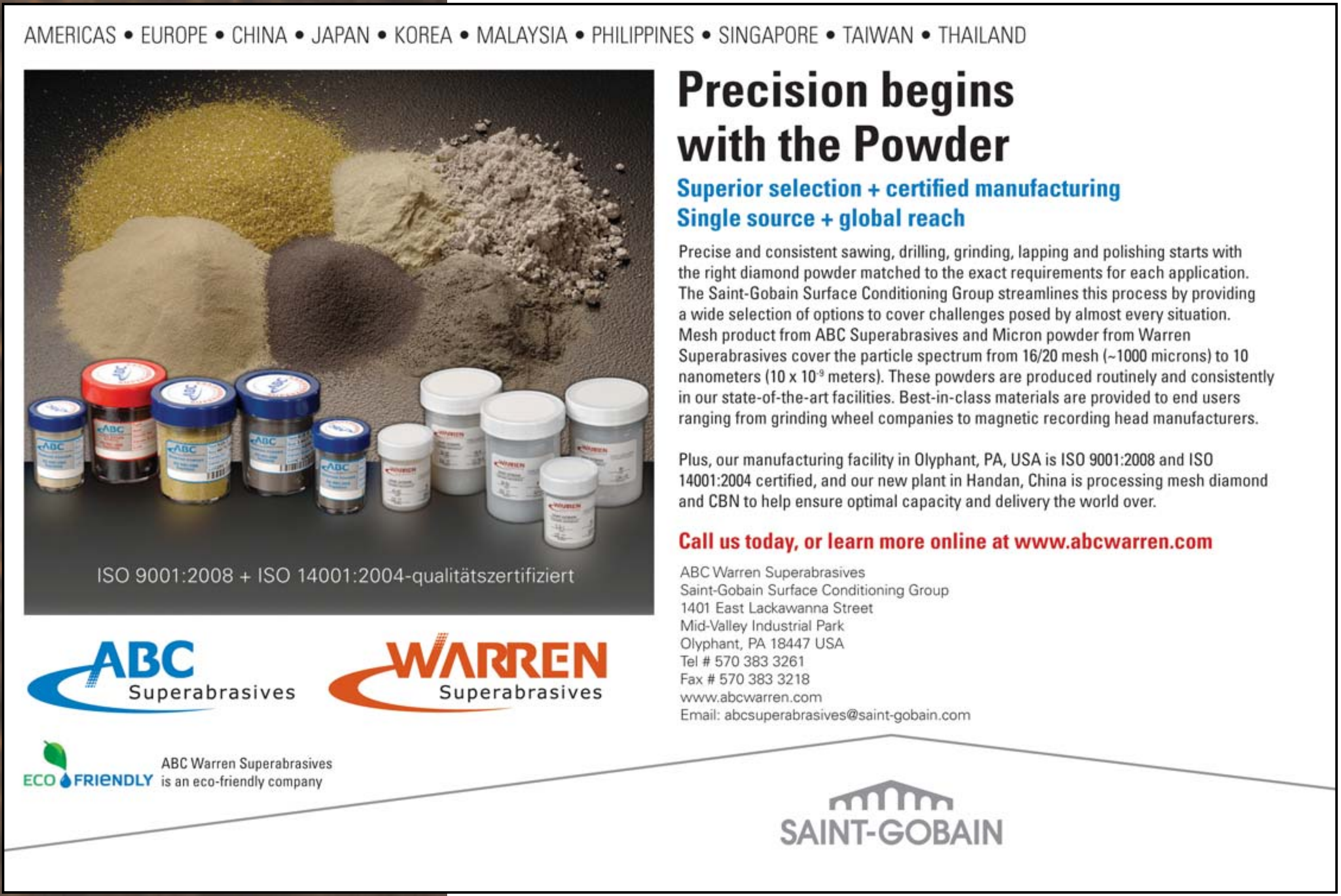
[a] *ELEMENT SIX LIMITED, Global Innovation Centre, Fermi Avenue, Harwell Oxford, Didcot, Oxfordshire, OX11 0QR, United Kingdom*
[b] *TECHNISCHE UNIVERSITÄT HAMBURG-HARBURG, Institut für Produktionsmanagement und – Technik, Denickestraße 17, 21073 Hamburg, Germany*

elementsix™
a De Beers Group Company

ABSTRACT: Carbon fiber reinforced polymers (CFRP) have, for many years now, been used extensively in high-end applications, such as aerospace and motorsport. The changing market requirements of fuel economy and reduction in emissions in the aerospace and commercial automotive industries have led to increased interest of the benefits of CFRP. High specific strength and stiffness combined with relative low weight makes CFRP materials ideal for numerous applications in these and other, industries. With the need to integrate CFRP technology into these cost saving products, comes the need to improve manufacturing capabilities. Although much research has centred around technologies aiming to achieve final shape parts, there is still a large portion of the components manufactured which require varying degrees of finish machining. CFRP materials are well known to be extremely difficult to machine, due to their anisotropic nature of the composite and highly abrasive nature of the fibers resulting in rapid tool wear. Workpiece surface defects play a large role in the machining of CFRP's, with delamination and fiber breakout affecting the fibers and thermal damage affecting the resin matrix. Defects must be kept to a minimum to ensure the material integrity within the structure and to minimize costly reworking.

This paper details the performance and cost benefits of the next generation of tool formats of Polycrystalline Diamond (PCD) materials, intended for, but not limited to, application usage in CFRP's. It provides an insight into the process of milling and trimming of CFRP materials and investigates the types of tooling currently used within industry, while detailing where PCD tool materials can play important roles. The body of work demonstrates the flexibility of these latest formats through multiple tool designs and their relative performance compared to tooling used widely in industry.

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at
www.intertechconference.com



AMERICAS • EUROPE • CHINA • JAPAN • KOREA • MALAYSIA • PHILIPPINES • SINGAPORE • TAIWAN • THAILAND

Precision begins with the Powder

Superior selection + certified manufacturing
Single source + global reach

Precise and consistent sawing, drilling, grinding, lapping and polishing starts with the right diamond powder matched to the exact requirements for each application. The Saint-Gobain Surface Conditioning Group streamlines this process by providing a wide selection of options to cover challenges posed by almost every situation. Mesh product from ABC Superabrasives and Micron powder from Warren Superabrasives cover the particle spectrum from 16/20 mesh (~1000 microns) to 10 nanometers (10 x 10⁻⁹ meters). These powders are produced routinely and consistently in our state-of-the-art facilities. Best-in-class materials are provided to end users ranging from grinding wheel companies to magnetic recording head manufacturers.

Plus, our manufacturing facility in Olyphant, PA, USA is ISO 9001:2008 and ISO 14001:2004 certified, and our new plant in Handan, China is processing mesh diamond and CBN to help ensure optimal capacity and delivery the world over.

Call us today, or learn more online at www.abcwarren.com

ABC Warren Superabrasives
Saint-Gobain Surface Conditioning Group
1401 East Lackawanna Street
Mid-Valley Industrial Park
Olyphant, PA 18447 USA
Tel # 570 383 3261
Fax # 570 383 3218
www.abcwarren.com
Email: abcsuperabrasives@saint-gobain.com

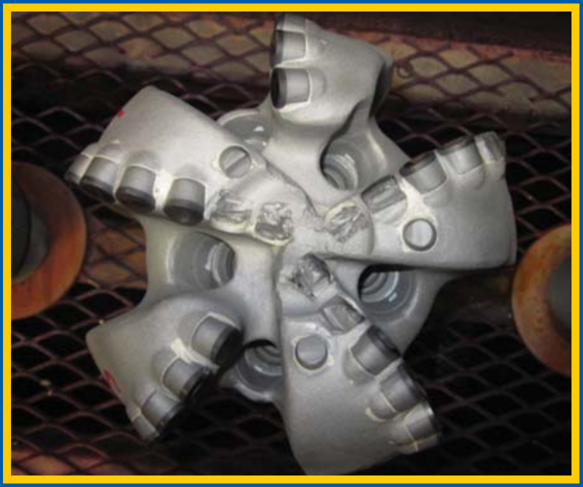
ISO 9001:2008 + ISO 14001:2004-qualitätszertifiziert

ABC Superabrasives

WARREN Superabrasives

ECO FRIENDLY ABC Warren Superabrasives is an eco-friendly company

SAINT-GOBAIN



Engineered Geometries for PDC Cutters extends the Life and Performance of PDC Drill Bits

D. SCOTT, D. STOCKEY
DR. A. DIGIOVANNI
Baker Hughes Incorporated

BACKGROUND:

From the early years of the PDC bit industry the bit manufacturers have occasionally taken the initiative to modify and adapt standard cutters available from the cutter manufacturers to different applications and to improve the behavior and performance through external geometry features and post synthesis treatments in order to differentiate their products from others. Several such concepts are highlighted in the following. An early example of such features is the chamfering of the table on stud mounted cutters by Stratabit which improved the edge chipping resistance and the cutter durability.[1] The benefit of a stress relief anneal was studied and commercialized by Hughes Tool Co. when they had the Hughes Diamond Products product line later sold to Dresser. Reduction in cracking from the negative effects of high residual stress[2-4] was noted. Hughes Christensen pioneered studies on the effect of surface finish and formation-drilling fluid-cutter interaction which resulted in the patented polishing of PDC cutters in oil and gas drill bits which in testing showed substantial improvements in bit performance which was well documented in the SPE literature.[5,6] They also developed and patented the widely used buttressed edge double chamfer known as the carbide supported edge (CSE)[7,8], and radiused edge cutters.[9]

Drilling performance in the laboratory and in the field is often measured in terms of the mechanical specific energy, which is a derived value that relates to the efficiency at which mechanical work can destroy and remove rock.[10] Often abbreviated, MSE, this metric allows a useful comparison of drilling efficiency across the extremely wide drilling conditions and drill bit designs used therein. MSE can also be determined for a single cutter and is also a very effective tool to examine the geometrical effects of cutter design in the laboratory. The individual cutter performance contributes strongly to the bit performance and in the laboratory, is a convenient way to develop these technologies as this paper will discuss.

The very edge of the PDC cutter that first engages the rock in the sharp state is the chamfer. Not surprisingly, the chamfer geometry will have a tremendous influence on the efficiency of the cutting process as determined by the MSE. A knife edge – infinitely sharp – chamfer would be extremely efficient. However, because there is a trade-off with durability, knife-sharp cutting inserts are never used. Thus, a chamfer size and orientation becomes a design balancing act, often being tailored for a given drilling application.

Selective use of chamfer sizes in specific areas on bits is a widely used feature developed and patented by Hughes Christensen.[11] Smaller chamfers can withstand the relatively benign dynamic loads encountered in the inner portion of the bit and improve ROP while larger chamfers on the shoulder add durability. Non planar cutter faces have been proposed and some utilized with isolated success over the years, with much of this driven by the bit companies proposing and patenting the geometry then working with a cutter manufacturer to make the cutters under a license or other proprietary agreement, or jointly developed by a bit company and cutter supplier. Examples are the convex cutter[12] (Sii- Megadiamnd), the DSE ultra thick cutter with an extended chamfer[13] (HCC-USS), the stepped cutter [14](HCC), contoured stud cutter[15] (NL Industries).

Although the benefits of surface leaching of the catalysts was studied by two PDC manufacturers, it was not patented nor commercialized for oil and gas drill bits, and was subsequently rediscovered and commercialized by a bit supplier. [16-19]

CURRENT DEVELOPMENT:

Recent studies by a bit manufacturer have focused on the behavior of a PDC cutter at the rock-cutter interface, and through that analysis, observations, intuition, empirical testing, extensive portfolio and experience with chamfer geometries, and engineering and scientific principles a new series of patented features have been developed and commercialized which have led to performance gains in the PDC

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

High-Pressure, High-Temperature Plastic Deformation of Sintered Diamonds

Julien Gasc [1], Yanbin Wang [1], Tony Yu [1], Ion Benea [2], Ben Rosczyk [2], Toru Shinmei [3] and Tetsuo Irifune [3]

[1] Center for Advanced Radiation Sources, the University of Chicago, Argonne National Lab, 9700 S. Cass Avenue, Argonne, IL 60439, USA
[2] Engis Corporation, 105 W. Hintz Rd., Wheeling, Il 60090, USA
[3] Geodynamics Research Center, Ehime University, Matsuyama 790-8577, Japan

ABSTRACT

The strength of Polycrystalline Diamond (PCD) was investigated through a high Pressure (P) and Temperature (T) deformation experiment. Two samples were sintered back to back under identical conditions and shared identical initial grain size distribution. One sample (4.4a) had lower concentration of crystalline defects than the other (3.4a). In crushing strength tests conducted prior to the deformation experiment, 4.4a exhibited an enhanced crushing strength compared to 3.4a. During the high P-T deformation experiment, the samples were stacked and deformed together and their mechanical properties were investigated in situ using synchrotron X-ray diffraction and imaging. The strain data based on imaging showed that the two samples were deformed at the same rate (ca. 1.5 x 10–5 s–1). Analysis of the diamond lattice plane distortions in the diffraction patterns showed that sample 4.4a exhibits slightly greater strength, especially towards large amounts of strain. We interpret this difference as due to a better sintering for 4.4a, thanks to lower defect concentration and cleaner grain surfaces of the precursor powder, which results into stronger diamond-diamond bonding. These data suggest that the use of diamond grains with reduced defect concentration and cleaner surfaces as a precursor improves the bulk strength and the wear resistance of the resulting PCD.

1. Introduction

Diamond is the stiffest and hardest material known. Years of technical development for synthesizing large sintered Polycrystalline Diamond (PCD) parts has made diamond a material of choice for various types of machining tools and engineering processes. One example of such applications is oil and gas drilling, for which it is known that PCD bits have the greatest wear resistance. The comparative studies available on PCD's mechanical properties –for the most part, based on indentation tests, i.e., Knoop hardness tests (Harano et al., 2012; Kurio et al., 2012; Sumiya, 2012)– show that PCD surpasses by far all other materials typically used for similar applications, such as WC.

PCD DRILL BIT

The performance of PCD bits is essentially determined by their ability to resist fracture under loading. During a down-hole impact event, the PCD bit absorbs energy, by deforming under the applied load. PCD bits with higher strain energy capacity will be able to absorb more impact energy during drilling without exceeding the diamond tensile limit (Harano et al., 2012; Kurio et al., 2012; Mukhopadhyay and Bertagnolli, 2011; Qian et al., 2012; Sumiya et al., 2012). Therefore, the strength and the fracture toughness of the PCD are the main properties that control its wear resistance and durability. The failure mode of the PCD bits (intra-granular vs. inter-granular fracture) is not well understood, although it is known that it depends on the concentration of crystal defects in diamond powder precursors as well as on the quality of the sintering, i.e., the strength of the diamond-diamond bonds.

The elastic properties of single crystal diamonds and PCD's have been extensively described in the literature (Chang et al., 2014; Dewaele et al., 2008; Kono et al., 2009; McSkimin et al., 1972). The strength of PCD's, however, remains poorly documented, essentially due to the difficulty to deform diamond plastically at ambient conditions (Weidner et al., 1994; Yu et al., 2012). A way to access plastic deformation of diamond is to perform it at high temperature, where ductility is enhanced (Weidner et al., 1994). However, this requires high pressures in order for the diamond to remain thermodynamically stable and not react back to graphite. In this context, we have performed a high pressure (P) and temperature (T) deformation experiment during which the mechanical properties of PCD samples were investigated in situ using synchrotron diffraction and imaging techniques. During this experiment, two samples were deformed together, under identical P-T conditions. The samples were extracted from PCD cutters for oil and gas drilling, sintered from two different monocrystalline diamond powder precursors sharing identical particle shape and size distribution. However, for one sample, 3.4a, a standard diamond powder (unprocessed for the reduction of crystallographic defects) was used, whereas for the other one, 4.4a, the precursor powder was processed through mechanical, thermal and chemical steps to reduce the concentration of crystallographic defects in the grains. This results in a larger mechanical strength of the individual grains as evidenced by the crushing strength test results (see section 2.1 for details), which in turn may be responsible for enhanced wear resistance of the PCD. In the present study, we report characterization of the two precursors and investigate how the difference in the precursors impacts the quality of the sintering and bulk strength of the PCD.

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

NEWS &notes

ABRASIVE TECHNOLOGY ANNOUNCES THE FORMATION OF MANUFACTURING WITH HEART, INC.

This consulting and coaching business will work with small manufacturing companies to share strategies to help owners and senior executives understand the underpinnings of heart culture, why it matters, and how it shows up in the productivity, turnover rates and bottom line of manufacturing organizations. Over the past 20 years, Abrasive Technology has developed a unique organizational structure based on Michael Hammer's concepts of a Process Centered Organization (PCO) and a positive company culture through development work with the Center for Creative Leadership. This unique model is documented in a new book, Manufacturing with Heart, A Holistic Approach, a roadmap for transformational changes in culture and organizational structure that aligns actions to the core belief that people can be trusted. PCO replaces the traditional hierarchical organization of Vice Presidents, Managers and Supervisors with a flatter structure of Leaders (Process Engineers and Coaches). The result is employees feel more connected to their contributions, decisionmaking and outcomes of the business. New ways of doing things lead to new insights, and new insights lead to more productive, collaborative, and meaningful behavior. For more information visit: www.abrasive-tech.com

FORD PLANS MOVE FOR COMPACT CAR PRODUCTION OFFSHORE

Ford plans to manufacture its Focus and C-Max at a location outside the USA within three years. Ford will build other products at the Michigan plant that currently builds those models. Ford has announced plans to move production of two of its smaller cars from its assembly plant in Michigan to a plant abroad by 2018 in order to maintain competitiveness. Ford did not say where it would relocate production of the Focus and C-Max, but reports say Mexico was likely. The Focus is already produced at several locations around the world. The announcement came as Ford and two other large U.S. automakers, General Motors and FCA US, the former Chrysler, gear up for new contract talks with the United Auto Workers (UAW) union.

HALLIBURTON AND BAKER HUGHES PROVIDE UPDATE ON PROPOSED ACQUISITION

Halliburton Co. and Baker Hughes Inc have agreed to extend until at least Nov. 25 the Justice Department's antitrust review period of their $35 billion merger. Halliburton also has proposed to competition authorities a plan to divest more businesses than had been previously announced. The agreement with the Justice Department extends the review period to Nov. 25 or 90 days after both companies have certified substantial compliance with the Justice Department's second request, whichever is later. The companies said they expect to achieve substantial compliance by midsummer. Halliburton and Baker Hughes now expect the deal to close no later than Dec. 1 and are still in discussions with authorities regarding the acquisition.

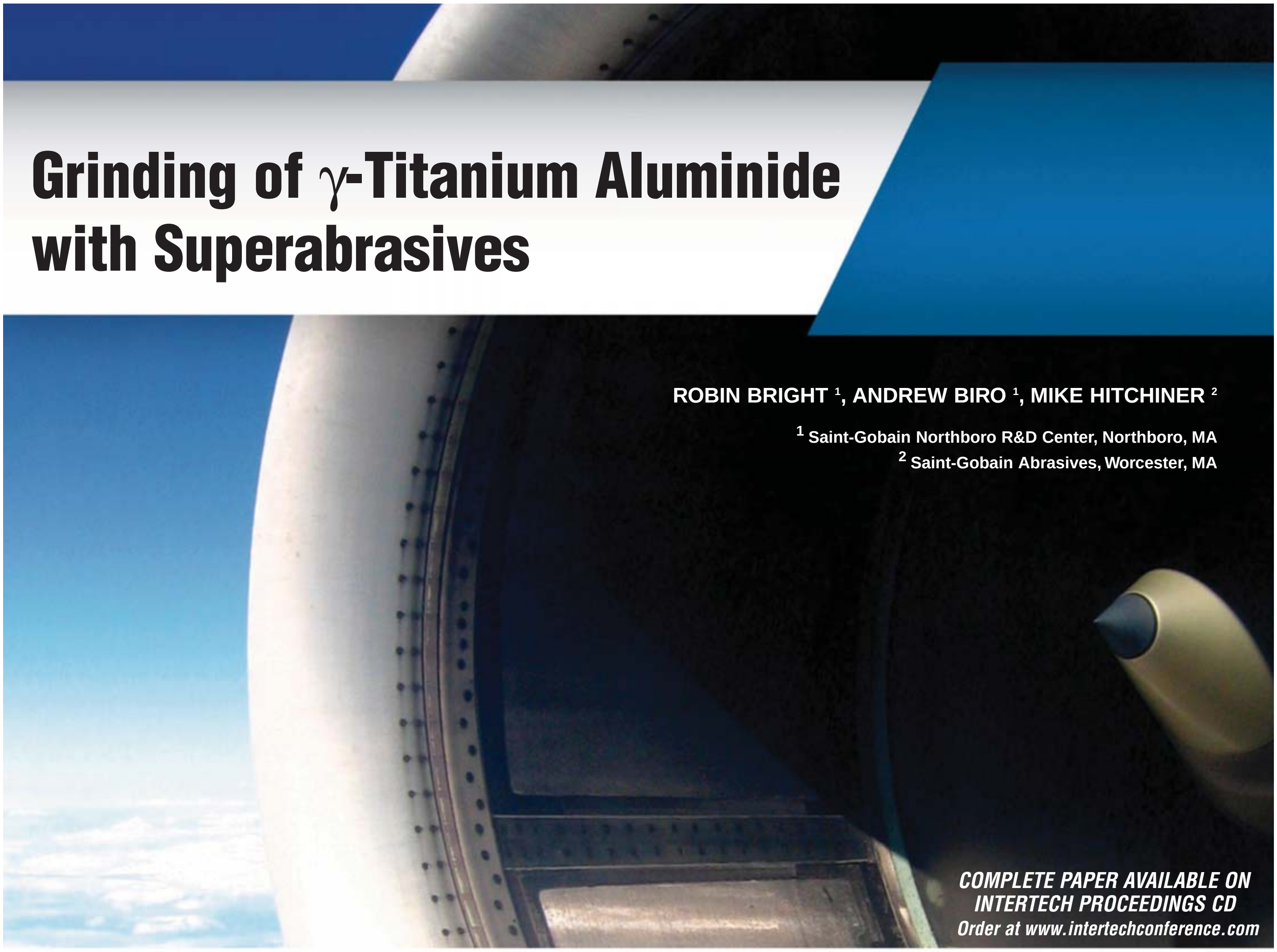
NEW "ABB IN MINING" WEBSITE CONTAINS ENHANCED CONTENT AND FEATURES TO MAXIMIZE USER EXPERIENCE

Zurich, Switzerland, July 10, 2015 – ABB, the leading power and automation technology group, now provides easier access to essential information regarding mining industry trends as well as its mining products, systems, solutions and services. Recognizing website visitors are under ever increasing time constraints, the site overhaul reflects part of ABB's ongoing efforts to make it quicker for professionals to access what they need and to engage more effectively with ABB. To that end, mining menus are streamlined and content consolidated to make it more straightforward for users to find and to differentiate between ABB's industry thought leadership viewpoints versus its practical applications as a mining specialist provider. The main areas where ABB is sharing its expert perspective include convergence (Next Level mining – defining the future), safety, security, integration, productivity and reliability. While the site's improved navigation functionality still allows readers to search for information through traditional categories such as products, systems, solutions and services, visitors can now browse material via the main steps in the mining value chain. The new site can be accessed via: www.abb.com/mining

Grinding of γ-Titanium Aluminide with Superabrasives

ROBIN BRIGHT [1], ANDREW BIRO [1], MIKE HITCHINER [2]

[1] Saint-Gobain Northboro R&D Center, Northboro, MA
[2] Saint-Gobain Abrasives, Worcester, MA



COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

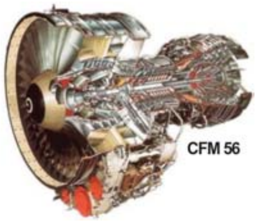
ABSTRACT

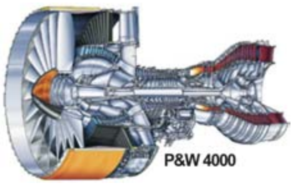
As gamma titanium aluminide (γ-TiAl) becomes increasingly attractive for use in high-temperature engine components, the ability to effectively and economically manufacture such components has become a key challenge for engine OEMs and their suppliers. Machining and grinding operations are particularly problematic, due to the brittle and burn-sensitive nature of this material. The traditional approach for grinding γ-TiAl includes the use of vitrified-bonded silicon carbide (SiC) wheels with high dress frequencies to avoid material damage (cracking, oxidation burn). This paper details results from recent g-TiAl grinding experiments utilizing superabrasive wheels, and compares results to those obtained from testing of traditional SiC grinding wheels. Results show a substantial technical benefit of diamond abrasive relative to both SiC and cubic boron nitride (cBN), and also demonstrate the potential of new dressable metal-bond wheel technology for high-productivity damage-free grinding of this material.

1. INTRODUCTION

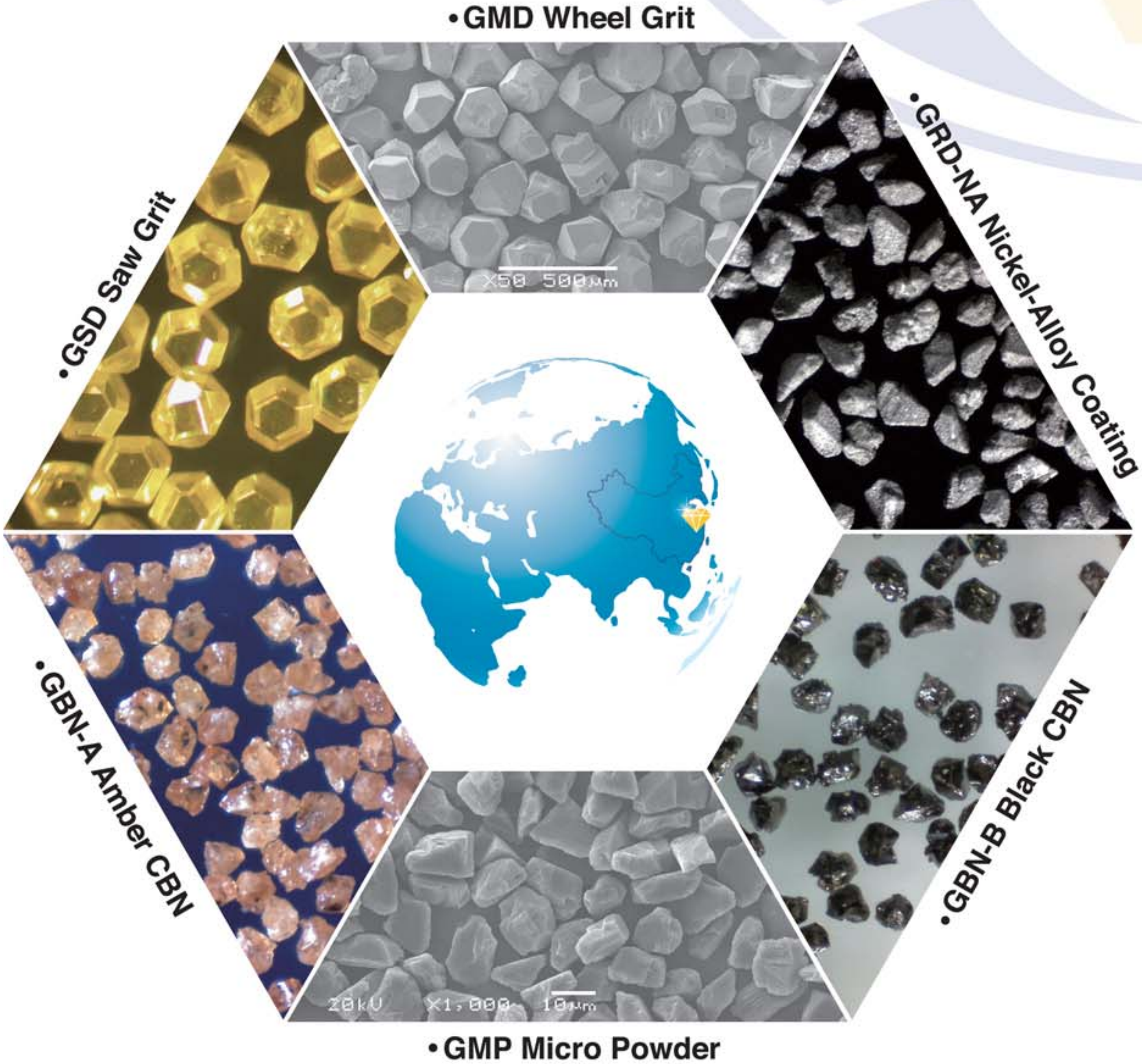
The need for improved fuel efficiency of commercial and military aircraft engines continues to drive the development and implementation of advanced materials, specifically where high-temperature stability and increased strength-to-weight ratios are critical. Recently-developed and next-generation engine designs will rely heavily on such advanced materials, which include the γ-TiAl family of alloys [1-3]. This material has already been implemented in low-pressure turbine blades for select engine types [4], and plans to utilize γ-TiAl for additional engine components have also been announced [5].

γ-TiAl is an intermetallic compound of titanium (Ti) and aluminum (Al), and typically includes small amounts of alloying elements such as niobium (Nb), chromium (Cr), manganese (Mn), or tungsten (W). The elemental composition of the most commonly used γ-TiAl alloys falls in the region of the phase diagram between 40 and 48 atomic percent Al, as shown in Figure 1. In this region, the microstructure is termed duplex due to the presence of both g-phase and colonies of lamellar structures which contain alternating plates of γ and α2 phases. The high specific strength and temperature stability of γ-TiAl relative to conventional titanium alloys and certain nickel-based superalloys (Figure 2) make it especially attractive for aerospace applications [7-10], although its use





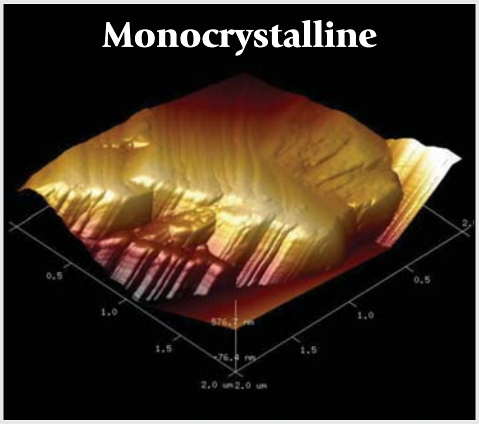
CR GEMS SUPERABRASIVES

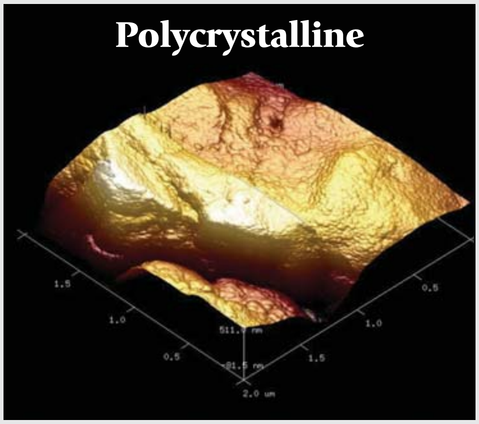


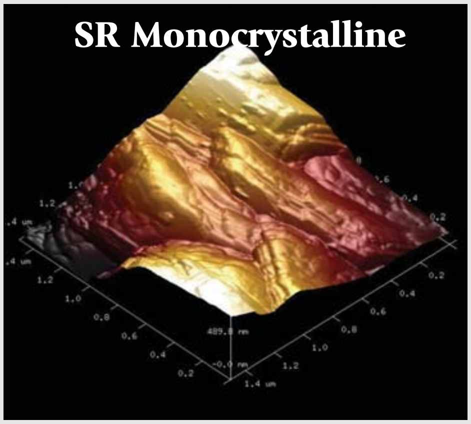
Diamond eyes
Discover new value

- ISO 9001 • ISO 14001 • OHSAS 18001
- Highly Recognized by International Tool Giants
- Performance Proved in CMP Pad Conditioner & Diamond Wire, etc

Add: No. 59 Shennan Road, Xinzhuang Industrial Park, Shanghai 201108, China
Tel: 86-21-6413 6696 Fax: 86-21-6413 6695 Email: crgems@crgems.cn **Web: www.crgems.cn**







The effect of diamond powder characteristics on lapping of sintered silicon carbide

Benjamin Rosczyk, Artem Titov, Eric Burkam, Clement Onyenemezu, Ph.D. and Ion C. Benea, Ph.D.
Engis Corporation, Wheeling, IL 60090, USA

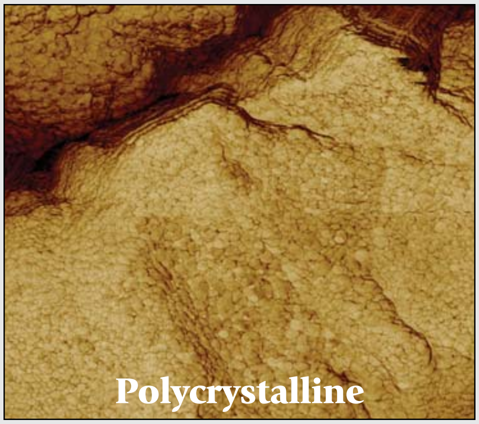
ABSTRACT

In Automotive applications, sintered Silicon Carbide has been used in applications such as seal pump faces. The surface of sintered SiC, when lapped or polished for sealing to another surface, must be free of blemishes and mechanical defects. Lapping and polishing processes therefore must be well defined and controlled assuring minimal variation and production scrap. In this study, we related the characteristics of different diamond powders (particle size distribution, particle shape and surface) to their performance in lapping of sintered silicon carbide material, expressed as removal rate and surface finish.

INTRODUCTION

Synthetic silicon carbide (SiC) is used in applications from abrasives to LED components, but most applications of sintered SiC, such as seal pump faces and wear plates, rely on the high hardness and wear resistance of this ceramic material. Sintered SiC is produced by pressureless sintering of ultrapure silicon carbide submicron powder in which SiC powder is mixed with non-oxide sintering aids, formed into the desired shapes by a variety of methods, and consolidated by sintering at high temperatures. The sintering process results in single-phase, fine grain SiC material which is lightweight, low in porosity, and extremely hard. Because of its hardness sintered SiC material can be effectively machined and lapped only with superabrasives such as diamond. Particle characteristics such as size, shape, surface roughness as well as friability all play a role in the lapping performance (material removal rate and surface finish) of abrasive particles during lapping of hard materials. Particle fracture (friability) tends to increase material removal rate by exposing new cutting points, yet from previous studies [1-2], as the particle size of the abrasive is reduced, the load per particle decreases and tends to reduce the degree of particle fracture and creation of new cutting points. Therefore, particle shape and surface characteristics tend to dominate the lapping performance of abrasives at finer particle sizes.

Synthetic diamond consists primarily of two types: monocrystalline and polycrystalline. Polycrystalline diamond tends to have a more textured, roughened surface than monocrystalline diamond because it consists of many micro-crystallites fused together in random crystallographic orientations which results in a rougher particle surface when crushed from larger feedstock. Conversely, during micronization, monocrystalline diamond tends to fracture



COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD • Order at www.intertechconference.com

Development of Ultra Fine Diamond PCD for Machining Al Alloys

Youl-Zhoo Sung*, DongKyun Shin, Heesub Park
ILJIN Diamond co., Ltd.

ABSTRACT

The recent trends of various machining industries are productivity improvement, use of hard to cut materials such as Al-alloys, and better surface finish. As a result of these trends, need for cutting tools made of Sub micron PCD has increased. In order to provide a solution for high speed milling and finishing of hard to cut materials, especially Al alloy, a new PCD grade made of sub-micron diamond has been developed. This new PCD is produced by sintering sub-micron grade of diamond and thus provides high level of wear resistance and toughness as well as excellent surface finish.

Keywords: PCD, Milling, Al-alloys machining

INTRODUCTION

In Recently, demand of Aluminum and Magnesium alloys has inceased with a efforts for light-weighting to reduce fuel comsumption and carbon dioxide gas emission in aerospace and automotive industries.

In Al-alloy machining, Ultra Precision and high speed machining was continuously demanded. This requirement should not obtained by conventional tungsten carbide cutting tools. Therefore PCD cutting tool is alternative for Al-alloys machining.

Recent Market trends derive to development of PCD tool for high speed and ultra precision machining.

FABRICATION

PCD has generally manufactured in High pressure and High temperature sintering condition. The ultra fine Diamond PCD was composed of under 1um diamond powder and applied new Process to improve dispersibility. Figure 5. Show that better dispersibility in the microstructure compared to the conventional process.

In this paper, the characterization and tool performance was compared by particle size. Generally, PCD was divided coarse, medium and Fine by particle size. And newly developed PCD was categorized for Ultra fine.

It was showed that characterization, microstructure, TRS, EDM cutting damage and edge sharpness of tool according to the 4different types in the table 1. Getting bigger diamond particle size EDM cutting damage was increased and the vice versa, the tool edge sharpness is better. The new developed Ultra Fine Diamond PCD is improved the EDM cutting performance and it's easy to make tool edge sharpness.

COMPLETE PAPER AVAILABLE ON
INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

Designer and Manufacturer of Quality Machine Tools Since 1974

DCM
ROTARY GRINDERS

WHERE THE FACE OF PRECISION BEGINS

DCM got the Point years ago when designing the "SD" series rotary grinders. Variable spindle RPM, table speeds, and feedrates can be optimized for Diamond & CBN abrasives. Programable parameters can be saved for repeatable performance in lab or production applications.

With over 30 years of machine design and manufacturing experience, DCM Tech builds a line of industrial grinders for a variety of applications. DCM grinders offer fast, close tolerance performance whether grinding metal, glass, carbide or ceramic. Innovative control packages provide process automation and repeatability. Integral mist collection and coolant filtration systems enhance grinding performance as well as shop cleanliness and operating conditions.

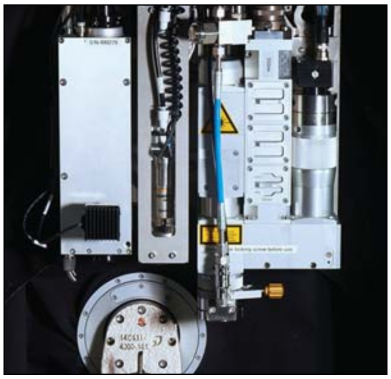
Made in U.S.A.

DCM TECH
4455 Theurer Blvd.
Winona, MN 55987
INTEREST@DCM-TECH.COM
1-800-533-5339
www.dcm-tech.com

Wetter is Better

New Developments in Wet Laser Machining for Industrial Diamond Tools

Dr. Peter J. Heath; Mr. Sébastien Kurzen – Synova S.A., Switzerland



INTRODUCTION

With a traditional dry laser, the machining is either carried out completely dry or under a gas atmosphere. Under such dry conditions, heat can build in the work piece, thermal expansion can result in distortions, brittle materials may crack and a large heat affected zone (HAZ) and oxidation may also result. A gas may give a better atmosphere but it does not have sufficient thermal capacity for adequate cooling. Last but not least, the cut produced by a dry, focused laser beam is "V" shaped – the kerf is wider at the entry side of the cut than at the laser's focal point at bottom of the cut.

A wet laser is very different. It works by first focusing the laser onto the aperture of a water jet nozzle. The water jet is typically 50 microns in diameter and up to 50mm in length before it turns to droplets. The laser pulses travel down this liquid optical 'fibre' by total internal reflection. The laser-water-jet cuts the workpiece by repeatedly scanning the required cutting pattern so deepening the trench. As a result, the cut produced is parallel sided rather than 'V' shaped and it is constantly cooled and cleaned of debris by the 300 bar water jet (Figure 1).

There are many application areas for the wet laser from drilling holes in ceramic coated, superalloy turbine blades to cutting gears for luxury watches. Various lasers can be employed but for the diamond industry, a Nd:YAG laser at a wavelength of 532nm and a pulse frequency of the order of a few kHz has been found to be the most appropriate. Water is particularly transparent to light of this wavelength. The scanning speed used is typically of the order of 10-20mm/sec and the amount of material removed at each pass is of the order of 20-50µm. In the following case studies, the various advantages of wet laser machining will become clear.

Over the last 2 years, there has been significant uptake of the wet laser in the gem diamond industry. Over 30 wet lasers[1] are now running for 'sawing' gem diamond in India, Belgium, Thailand, Russia and South Africa. Figure 2(a) shows a 200ct gem stone being cut into the required primary parts. More recently[2], the wet laser manufacturer has started to develop the techniques to expand applications and cut the major facets (Figure 2(b)) on stones so as minimize the amount of polishing required.

In comparison to dry lasers, the benefits of wet lasers for the gem diamond industry can be summarised as:

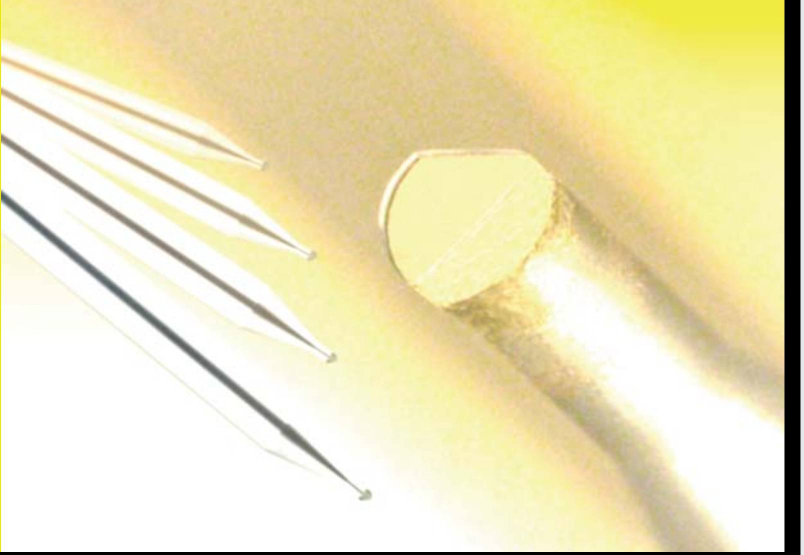
1. Increased yield (stone weight) via reduced breakage rate of stressed stones
2. Increased yield due to the narrower, parallel sided kerf
3. Faster cutting rates and higher productivity at higher laser powers without thermal damage
4. A simpler planning process as the kerf is not V shaped
5. Easier cutting as double sawing is not necessary – cuts 25mm deep achieved from one side
6. Flatter, more accurate facets ready for final polishing
7. Minimal sub-surface damage

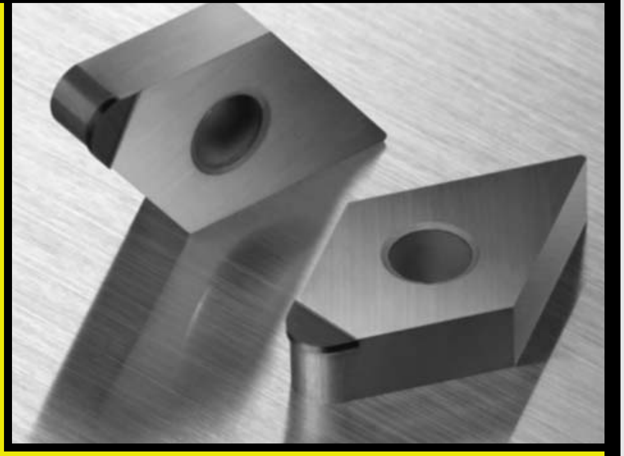
A most interesting capability of the wet laser is to make parallel sided holes in difficult materials or alternatively, the wet laser can be used to produce rods of any shape such as triangular, square or round cylinders. In Figure 3, a diamond rod 1mm diameter and 8 mm long has been cut from a natural diamond stone in less than 8 minutes. The end to end diameter of the rod produced was within ±2 microns.

Case Study 3: Cutting Synthetic, HPHT Diamond

One of the most common methods for single crystal diamond tool manufacture, be they natural or synthetic diamond, is to first braze the diamond to a tool body using a

COMPLETE PAPER AVAILABLE ON
INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com





Development of Nano-Polycrystalline Diamond Tools for Direct Cutting of Cemented Carbide

TOMOHIRO FUKAYA, HIROYUKI SHIMADA,
KAZUYA YANO AND YASUYUKI KANADA
Sumitomo Electric Hardmetal Corp.

ABSTRACT

There has been a growing demand for cutting tools that can be used for the direct cutting of cemented carbide materials to create high precision mold/die parts at low costs. However, conventional PCD tools are insufficient in chipping resistance, wear resistance, and edge sharpness. To address these challenges, the nano-polycrystalline diamond tools have been developed. The nano-polycrystalline diamond has extremely high hardness and strength with no anisotropic mechanical properties, and these cutting tools exhibit excellent performance in the direct cutting of cemented carbide.

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

1. INTRODUCTION

As electronic components and the like parts are becoming smaller and more precise in recent years, molds/dies materials for producing them are becoming harder in order to retain high precision for a long period of time. To produce higher-precision optical components and forging dies at lower costs , demand is growing for cemented-carbide molds/dies and therefore cutting tools that can direct milling of cemented carbide, as shown in Fig. 1. Cemented carbide materials are currently machined with electro discharge machining and polishing and it takes long time to produce. To reduce the machining time direct milling with diamond coated tools have been developed. But it is difficult to obtain a mirror-finish surface with diamond coated tool, an additional finish-polishing process is generally performed to produce higher-precision molds/dies. However, the finish-polishing makes molds/dies prone to dimensional errors. To overcome this problem, it is necessary to realize direct milling that can produce a high-precision mirror surface without the need of finish-polishing. Nano-Polycrystalline Diamond without binder phase (BL-PCD) has been developed to respond to the needs for machining such hard work materials with high efficiency, precision and quality, as shown in Fig.2. (1) The properties and performance of BL-PCD tool was described in this report.

2. THE PROPERTIES OF BL-PCD

Fig. 3 shows the synthetic condition of BL-PCD. BL-PCD is a nano-polycrystalline, single-phase diamond using graphite as the starting material. It is produced by directly converting graphite into diamond while allowing particles to be bonded together under ultrahigh-pressure and high-temperature conditions (15 GPa or higher and 2,200°C or higher) (1). Fig. 4 shows the microstructure of BL-PCD compared with conventional PCD. While the conventional PCD uses a cobalt binder to sinter 1 μm–20 μm diamond particles, BL-PCD is a new material with extra-fine diamond particles (30 nm–50 nm) bonded together directly without using any binder. Fig. 5 shows the knoop hardness of BL-PCD. The knoop hardness of conventional PCD is 40 ~ 70 GPa depending on grain size, and the hardness of synthetic diamond crystal is 80 ~ 120 GPa depending on crystal orientation. BL-PCD is extremely hard and the hardness is 110 ~ 130GPa. Fig. 6 shows the comparison of TRS and hardness of BL-PCD with various materials. The TRS of BL-PCD is about 3 GPa and better than that of conventional PCD. Furthermore the TRS of BL-PCD increase in high temperature, as shown in Fig. 7. Fig. 8 shows the comparison of thermal conductivity of BL-PCD. The thermal conductivity of BL-PCD is 300 ~ 400 W/m·k and almost the same as that of coarse Co binder PCD, Compared with single crystal diamond, the thermal conductivity is low due to the dispersion of the phonon at the interface between the particles. Table 1 shows the summery of mechanical and thermal properties. A cutting tool using this revolutionary BL-PCD for the edge provides the following characteristics.

(1) Harder than single crystalline diamond, the BL-PCD tool is capable of machining harder material with higher precision for a longer period of time than with any conventional cutting tool.

(2) Unlike single crystalline diamond, BL-PCD does not have anisotropic properties and is therefore free from uneven wear associated with crystallographic orientation, enabling high-precision profile machining for a long period of time.

(3) Unlike single crystalline diamond, the polycrystalline BL-PCD does not have the cleavage property and provides high chipping resistance.

(4) BL-PCD is a polycrystalline sintered compact of nanometer-level ultra-fine diamond particles and is therefore superior to conventional PCD in edge sharpness, producing good surface roughness.

Announcements & PRODUCTS

LACH DIAMOND AT COMPOSITES EUROPE TRADE FAIR SEPTEMBER 22ND – 24TH, 2015 IN STUTTGART/GERMANY

Composite materials – glass fiber and carbon fiber reinforced plastics (GFRP / CRP) – are an essential part of today's technology and daily life. Composites are lightweight materials with multiple benefits. They are vital components in aircraft production and help minimize fuel expenses; wind turbine blades are also made out of composites and they are widely used in the automobile and sports equipment industry. Bike manufacturers have a long standing tradition of using these lightweight materials for the benefit of their consumers. Even engineers who design skyscrapers and bridges experiment with CRP materials in order to make their constructions more resistant and durable against environmental impacts than traditional steel elements. LACH DIAMOND has developed specialized diamond tools that are as versatile as the composite materials and their multiple applications. Visit LACH DIAMOND at booth 7/A25 to see this fascinating multi-facetted world of composite tooling. ***For more information visit: www.lach-diamond.com***

FIVES GLOBAL SERVICES' NEW PROCHECK MACHINERY EVALUATION PROVIDES A DETAILED REPORT ON THE CONDITION AND CAPABILITY OF MACHINE TOOLS AND OTHER MAJOR PLANT EQUIPMENT.

HEBRON, KY. JULY 1, 2015 –A ProCheck inspection for machine tools begins with a 3-axis ballbar test that evaluates 11 areas including circularity, squareness, backlash, axis reversal spikes and straightness. Other tests include: Measurement of spindle clamping force and runout - Ultrasonic scanning of critical plant/machine systems for bearing vibration/noise, air leaks, pump cavitation, and electrical anomalies.- Infrared thermographic inspection of bearings, motors, pumps and electrical systems. - Refractometer testing of coolant condition, concentration and pH level, as well as measurement of tramp oils. - Ground loop and current leakage testing of electrical systems. ***For more information visit: www.fivesgroup.com***

ELEMENT SIX GAN-ON-DIAMOND NAMED SEMICONDUCTOR MATERIAL OF THE YEAR BY ELECTRONIC DEVICE INDUSTRY NEWS

SANTA CLARA, CA. JUNE 8, 2015 – Element Six – a world leader in synthetic diamond supermaterials and member of The De Beers Group of Companies – was presented with the Grand Prix for semiconductor materials. Element Six earned the program's highest honor for its innovative GaN-on-Diamond 4 inch wafer. Leveraging technology initially developed more than 10 years ago, Element Six Gallium Nitride (GaN)-on-Diamond wafer technology was the first-of-its-kind to be commercially available. In recent years, the GaN-on-Diamond market has expanded and Element Six's synthetic diamond was proven, by Raytheon Company, to significantly outperform industry standard Gallium Nitride-on-Silicon Carbide (GaN-on-SiC) in RF devices. The study showed that GaN-on-Diamond substrates, fabricated by Element Six, dissipate heat more than three times more effectively than silicon carbide. ***To learn more, please visit: www.e6.com***

VOLLMER RELEASES SIX NEW MACHINES

The sharpening of carbide tipped circular saw blades has now been taken to a new level of productivity and precision. Both the CHP 840 and CHP 1300 are universal sharpening machines with four CNC-controlled axes for hook and clearance surfaces for the complete machining of all commonly found tooth geometries. With five CNC-controlled axes the CHF 840 and CHF 1300 machines are able to machine the tooth sides of carbide-tipped circular saw blades. Many within the saw mill industry, as well as companies, that process wood, plastics, aluminium, and metal, use Vollmer machinery for side grinding. The CHC 840 and CHC 1300 are specifically conceived for the particular requirements of sharpening services and saw mills. Like the CHP it is also equipped with four CNC-controlled axes and is known for its economical sharpening. ***For more information visit: www.vollmer-group.com***

YOUR SOURCE FOR DRAW QUALITY TITANIUM, NIOBIUM AND ZIRCONIUM

ULBRICH STAINLESS STEELS
& SPECIAL METALS, INC.
EMAIL TiNbZr@ulbrich.com
203 239-4481

WWW.ULBRICH.COM

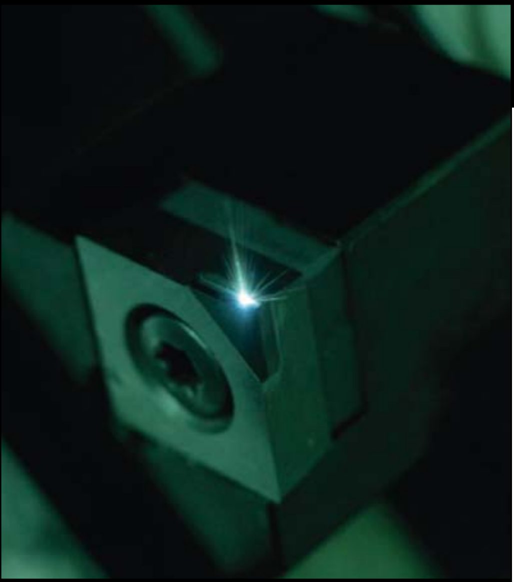
Ulbrich

GLOBAL PARTNER IN THE STAINLESS STEELS AND SPECIAL METALS MARKET SINCE 1924

CUSTOM PRECISION ROLLED STRIP, FOIL AND WIRE

TIGHTER THAN INDUSTRY STANDARD TOLERANCES

13 LOCATIONS WORLDWIDE



Nanosecond laser processing of diamond materials

Mr. Jan-Patrick Hermani; Dr.-Ing. Michael Emonts; Prof. Dr.-Ing. Christian Brecher

ABSTRACT

Laser processing of synthetic diamonds for tooling application has been industrially established since the early 2000's. Though there are many publications dealing with the interaction between laser radiation and diamond materials using scientific laser sources, there are no comprehensive studies available for achievable ablation rates using industrially wide spread nanosecond laser sources. This paper will focus on the investigation of laser ablation results for various monocrystalline and polycrystalline diamond materials using a NIR laser source with maximum pulse energy of 1 mJ. Single pulse ablation results for different laser parameters show that the ablation depth for polycrystalline diamonds is limited by absorption of laser radiation in the plasma plume. The plasma plume is visualized by high speed photography and correlated to the ablation results.

The nanosecond laser ablation process for monocrystalline diamonds strongly depends on the impurities, especially the nitrogen content. For high-purity monocrystalline diamonds spectroscopy analysis show almost no NIR-absorption. As there is no multi-photon absorption for nanosecond laser irradiation ablation can only be achieved by use of an absorption coating. Experimental results show that the initial absorption of laser radiation in the coating leads to thermally-induced formation of a graphite layer on top of the diamond. This graphite layer enables absorption of NIR laser radiation and further ablation without the need of an additional absorption coating.

INTRODUCTION

The outstanding properties of cutting tools made of diamond materials make these tools ideal for machining light metals, FRP and wood in economically efficient operations. However the degree of hardness and the level of wear resistance present enormous challenges throughout the processes involved in manufacturing the cutting tools. Low material removal rates and heavy abrasive disk wear make conventional finish machining operations through grinding, both costly and time consuming. Laser processing offers the big advantage to effectively run without any tool wear.

Synthetic diamonds are produced either by high pressure high temperature processing (HPHT) or chemical vapor deposition (CVD). Both manufacturing techniques are able to produce monocrystalline diamonds (MCD) as well as polycrystalline diamonds (PCD). Most diamonds used for tooling applications are HPHT-PCD. Figure 1 shows a typical process chain for a diamond tool manufacturing process. PCD blanks manufactured by HPHT usually are diskshaped consisting of a cemented carbide substrate with a PCD top layer. Single PCD cutting inserts are manufactured by cutting the PCD blank into pieces by either wire electrical discharge machining or laser cutting. The cutting process results in a thermally affected rim zone which has to be removed before using the tool. In a next step the cutting inserts are brazed on tool holders. The brazing process causes dimensional and angular errors which also have to be removed to achieve a high shape accuracy of the diamond tool. In a final finishing step the affected rim zones as well as the brazing errors have to be removed and the macro geometry (corner radius, clearance angle) and the micro geometry (cutting edge, chip breaker) have to be manufactured.

Conventional machining techniques for the finishing step are grinding as well as electrical discharge machining. Since the early 2000's laser processing has been industrially established as finishing technique. Single laser pulses are positioned next to each other creating grooves into the material. By repeating groove by groove whole layers can be removed. The PCD material allowance is removed layer by layer.

COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com

High Performance Machining of Brake Discs with PCBN Cutting Materials and customized Tooling

JOHANNES SCHNEIDER
CeramTec GmbH, SPK Cutting Tool Division

ABSTRACT

As a product of high volume production the economics and productive manufacturing of the brake discs is a fundamental issue to ensure the competitiveness of the manufacturers. The output and final cost per part are highly influenced by the manufacturing technology, the cutting materials and tooling systems applied. Further development of Ceramics and PCBN (Polycristalline Cubic Boron Nitride) cutting materials, customized tooling and work path planning are the basics for best machining results and minimum manufacturing costs.

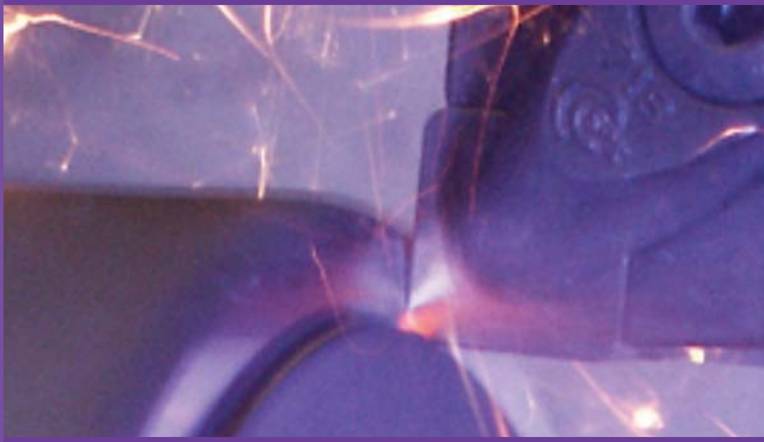
Brake discs and brake drums of motor vehicles are made from grey cast iron in more than 90% of all applications. Cost per part and the output per time are highly influenced by the cutting materials, customized tooling and work path planning. Cutting speeds up to vc = 1200 m/min and higher and feed rates up to f = 0,8 mm are applied with high performance cutting materials in roughing. High surface qualities in the finishing process are realized by applying special geometrical designs to the finishing inserts. In combination with customized, multi inserted bladed tools, the shortest machining times and the highest productivity at optimal manufacturing cost per part will be achieved.

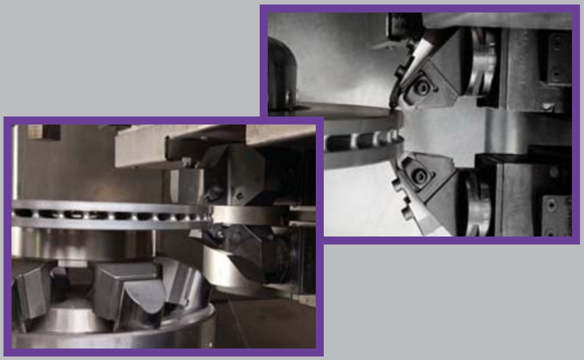
Cutting Materials for Brake Disc Manufacturing

Higher efficiency in manufacturing is mainly achieved by higher production rates and higher cutting data. Due to their unique characteristics of high hardness, wear resistance and hot hardness combined with a good compressive strength, thermal shock behavior and toughness, Ceramics and PCBN materials are perfectly suited for cutting applications at elevated cutting data, also under unfavorable conditions such as interrupted cut or uneven depths of cut.

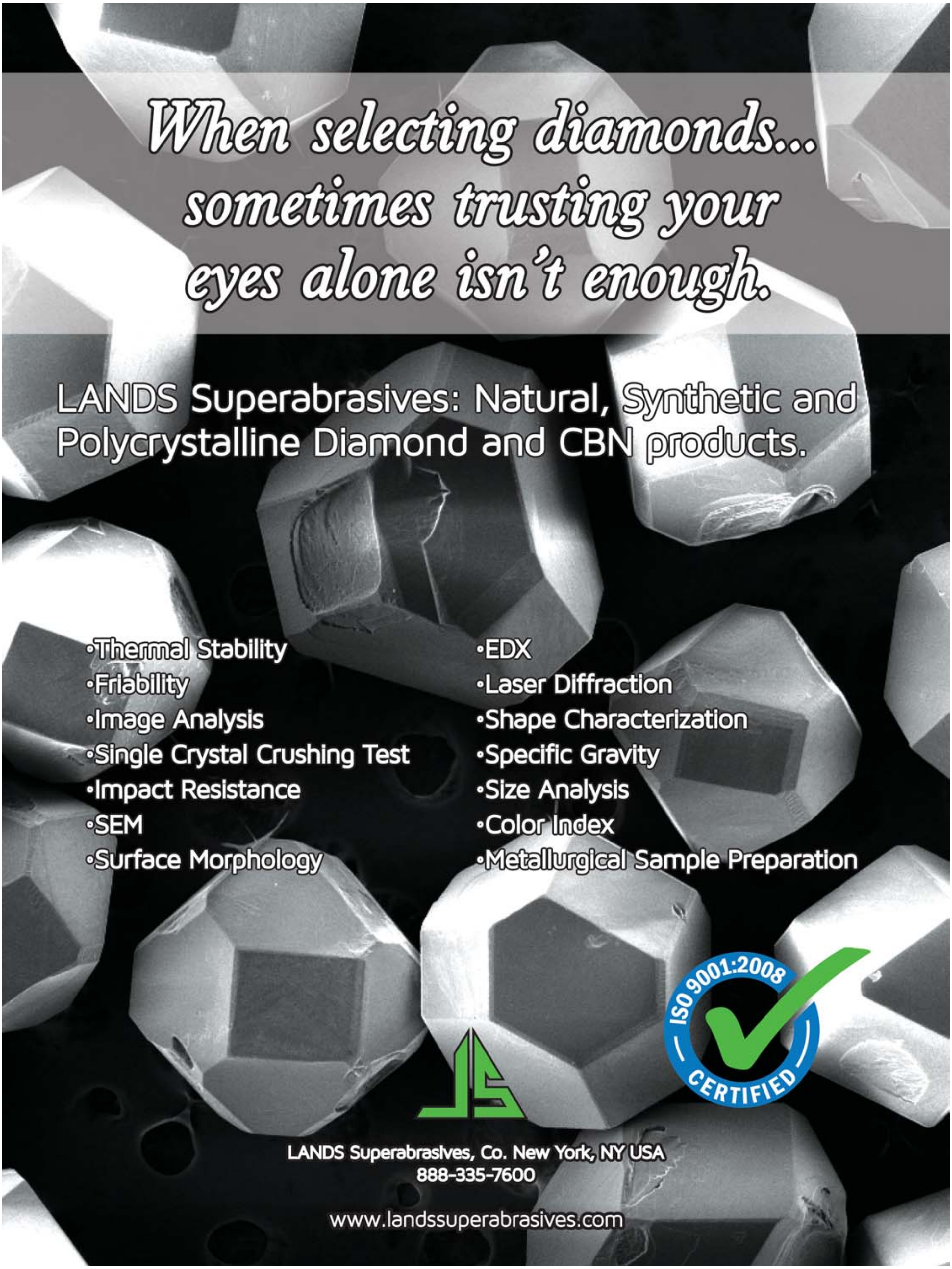
During the last decades, silicon - nitrides / SiAlON and PCBN grades became the standard cutting material for all HPC-turning of grey cast iron materials. Especially when machining high volume components, such as brake discs, the highest speeds and feeds are achieved, leading to shorter machining times, increased productivity and unbeatable economics. PCBN Cutting materials play an important role in High Performance Machining of cast iron materials (GJL).The process efficiency in cutting CI can be related directly to the machining parameter.

PCBN as a non-metallic material and inorganic compound is fulfilling the definition of a ceramic material with special characteristics. PCBN cutting materials are characterized by a multi-phase structure comprising of PCBN grains of different sizes embedded in a binder matrix (either of metallic or ceramic origin).





COMPLETE PAPER AVAILABLE ON INTERTECH PROCEEDINGS CD
Order at www.intertechconference.com



When selecting diamonds...
sometimes trusting your
eyes alone isn't enough.

LANDS Superabrasives: Natural, Synthetic and Polycrystalline Diamond and CBN products.

- Thermal Stability
- Friability
- Image Analysis
- Single Crystal Crushing Test
- Impact Resistance
- SEM
- Surface Morphology
- EDX
- Laser Diffraction
- Shape Characterization
- Specific Gravity
- Size Analysis
- Color Index
- Metallurgical Sample Preparation

ISO 9001:2008 CERTIFIED

LANDS Superabrasives, Co. New York, NY USA
888-335-7600

www.landssuperabrasives.com

THIS SIMPLE CIRCLE IS SHAPING THE FUTURE

It may not look like it, but this circle represents an industry first. The CMX850 from Element Six is the world's most technically advanced and versatile grade PCD, enabling tool makers to produce sharper, faster, multi-purposed performance enhancing tools - and reduce grinding costs by up to 25%. How? It's because of our continued commitment to innovation and excellence in the sector that tool makers and manufacturers around the globe are successfully using our CMX850 material today. Join them.

+1(844)E6Texas | www.e6.com | ussalesorders@e6.com

elementsix™
a De Beers Group Company